

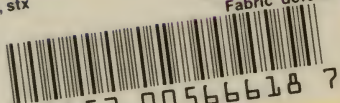
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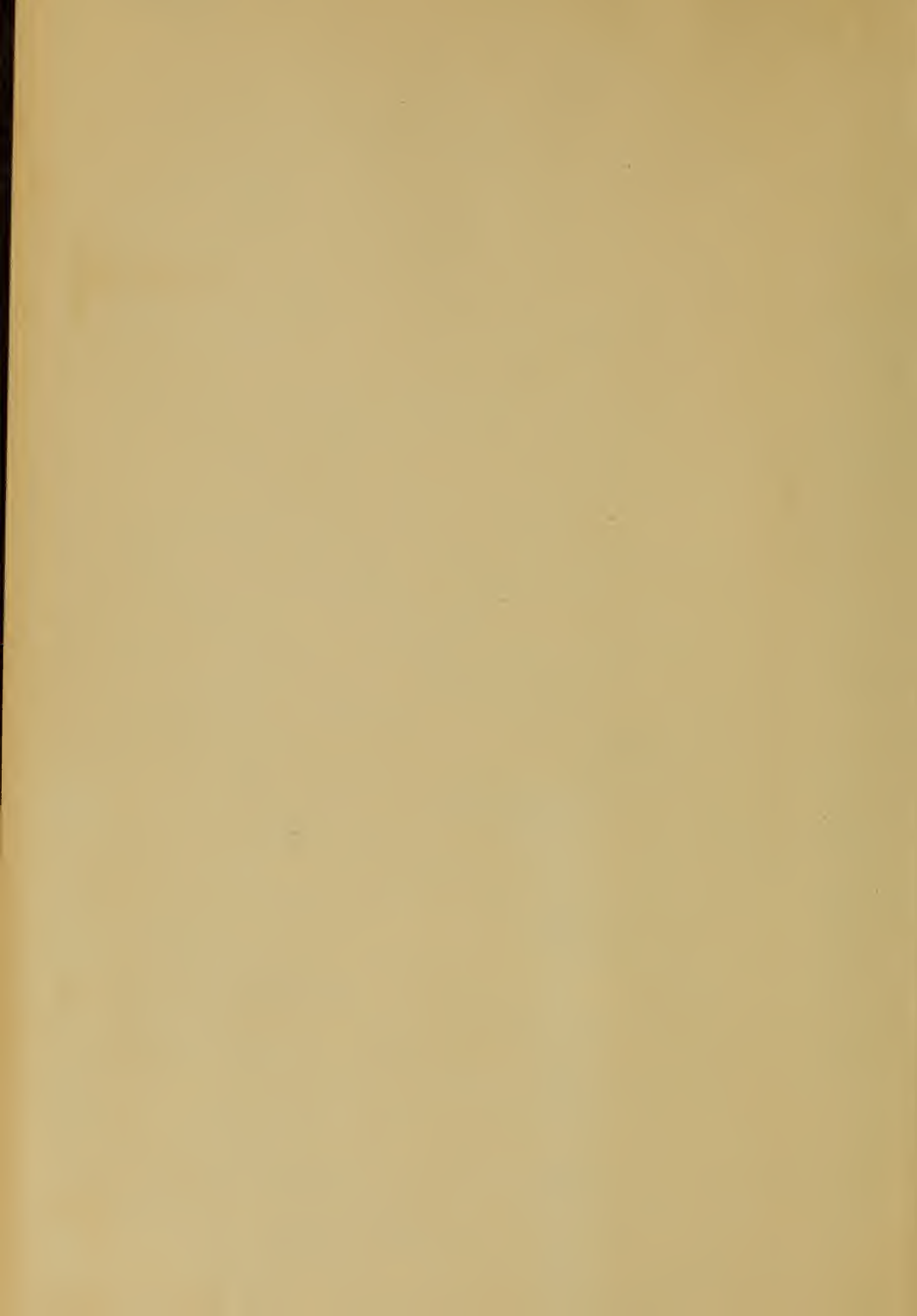
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TEXTILE TECHNOLOGY SERIES

C. W. BENDIGO, *Consulting Editor*
Editor-in-Chief, Textile World

FABRIC DEFECTS

FABRIC DEFECTS

CASE HISTORIES OF IMPERFECTIONS
IN WOVEN COTTON AND RAYON FABRICS

BY

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FABRIC DEFECTS

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To Sylvia

Who showed infinite patience and lasting devotion
To put up with the homework and frequent commotion
Brought on while recording each cloth imperfection—
Who else but my wife would respond with affection!

As a fitting reward for her unfailing loyalties,
All my thanks, all my love—and, of course, all the royalties!

FOREWORD

Perhaps one of the most elusive if not the most confusing of the problems which persistently face the textile technologist is the analysis of fabric defects. Invariably each case becomes in essence a "mystery drama" as to type, source, and responsibility.

The technologist finds himself precipitated into the role of private detective in a case where he is expected to "apprehend the culprit, determine the motive and reconstruct the crime," frequently with the aid of nothing more than a 1- by 1-inch piece of evidence and a somewhat colored recitation of the "pertinent facts of the case."

The "culprit," i.e., the type of defect classified as to cause, usually has a host of relatives, all of whom have been blessed (or cursed) with extremely similar if not identical features and characteristics. In fact conflicting textile terminology endows them with the further complication of a series of "aliases."

The "criminal records" at the sleuth's disposal are few and far between—no "fingerprint files," no "rogues gallery"—yet he is obliged to present a perfect case in court at the earliest possible date following receipt of his bewildering assignment!

How, oh, how should he proceed to a solution and yet retain his professional reputation?

If only there were some case histories for reference. Certainly there have been thousands of cases, but unfortunately they either were not recorded, or in those instances where records did exist they were hidden in the secret archives of various investigators.

How could records of such case histories be unearthed and made available to those unfortunate creatures who are repeatedly faced with these horrible enigmas?

Mr. Goldberg had been collecting such data for an extended period of time. Why not appeal to his spirit of sympathy and brotherly love? That seemed to be a logical step in the right

direction, and so after some years of effort he was prevailed upon to compile the contents of this important volume.

It represents years of work and the application of great skill in the attack of a knotty problem on a very broad front—and, mind you, without the benefit of documentary background which because of his patience, inquisitiveness, and efficiency is now available to all who feel the urge to search for the obscure in this field of endeavor.

But a few words of caution are in order. Frequently the problems presented appear to be most alluring—in fact, the solution seems to be in sight at the very start. As the investigation continues, hope is in the ascendancy at each step of the way. The answer is certainly just around the corner, but somehow Fate tempts, but seldom furnishes the “proper corner.” Time, which is of the essence, marches on—and the goal is still as elusive as at the start. This volume will aid in the quest, but alone may not provide the ultimate answer.

The photographs and the text must not be considered to be the analogue of “fingerprint files” or “rogues gallery” likenesses—and must not be employed as such. Rather they are guides to the establishment of an adequate set of records for the “sleuth’s” personal use.

The book certainly makes neither startling disclosures of “secrets,” nor suggestions that the text be used as a basis for making “claims” for fabric defects which resemble some of those described. It should be accepted and utilized for the extremely valuable purpose for which it was prepared—a documentation of “case histories,” presented in simple, nontechnical language, which will be of inestimable value to students, mill men, converters, technologists and others alike, and will fill an important long-existing void in reference libraries throughout the industry.

WALTER J. HAMBURGER

FABRIC RESEARCH LABORATORIES, INC.
BOSTON, MASSACHUSETTS
April, 1950

PREFACE

This book presents a series of case histories of defects in textile materials with some explanation of the contributing factors and suggestions for analyses. No attempt has been made to compile an encyclopedia which would enable the reader to immediately identify and analyze every known imperfection in gray and finished goods. Those who are even generally familiar with the complex processes involved in the manufacture of man-made fibers and the conversion of raw material to finished goods, are well aware of how impossible a task it would be to enumerate, analyze, and recommend a cure for all faults which may arise.

There are described in the following pages actual defects encountered by the author in his experience of 20 years in close contact with the manufacture, dyeing, and finishing of cotton, rayon, and other man-made fibers and blended yarn fabrics, as well as with garments fabricated therefrom. In many instances photographs and photomicrographs illustrate the fiber, yarn, and fabric faults, and only a brief comment is needed to describe the condition and the apparent cause. It is to be noted that, more often than not, no detailed explanation is given of how the faulty condition came about, since it is felt that such details are merely of academic interest to the layman and are generally known to the skilled technician, millman, dyer, or finisher. By simple analogy, the physician who is a good diagnostician need not tell his patient the exact process by which he acquired cirrhosis of the liver. The patient should be content to learn that he is not suffering from a heart attack, nor should he blame his condition on tight shoes. For the same reason that the man who finds his headaches due to eyestrain should not blame every headache on the same disorder, the reader should exercise enough intelligence to approach each new defect with an open mind and not be too quick to assume that, because there is a striking similarity in the symptoms, the cause and the cure are

identical. There are a great many known causes of warp streaks in a piece of cloth, all of which may be described as "headaches just like the one I had last week," but a very careful investigation of the sample and knowledge of the history of the fabric may reveal just one more symptom which classifies the condition as being slightly different from what appeared to be the case on first casual observation. And, very often, in spite of our experience, knowledge, and fine working tools, the answer is not definitely established.

It is the author's view that only ignorance is displayed by the investigator who draws a conclusion because he thinks it is expected of him, when the facts do not support the theory; but nobody will question the wisdom of an honest "I don't know," when the cause of a defect is indeterminate.

More for the sake of maintaining order than of providing a ready reference to the easy solution to a defect, the following material is classified as: (1) gray-goods manufacturing defects from raw fiber through weaving, (2) rayon or man-made yarn faults (since the spinner or the weaver generally purchases such yarns from a yarn producer), (3) dyeing and finishing faults, (4) imperfections which have appeared in finished garments, and (5) miscellaneous case histories.

The author is grateful to J. P. Stevens and Co., Inc., for permission to publish this book; and to Miss D. Tingley for transcribing the manuscript, to Miss E. Canales for her assistance in taking many of the photographs, and to other members of the Research Department who aided in analyzing a number of the defects.

JULIUS B. GOLDBERG

RIVERDALE, N. Y.
April, 1950

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CHAPTER 1

GRAY-MILL DEFECTS

Although to the converter or to the dyer and finisher any fabric defect which is not directly attributed to the dyeing and finishing operation seems rightfully classified as "gray-goods trouble," it is evident that this is not entirely a correct assumption. Obviously, the fault may be traced to the basic raw materials used, such as the cotton, rayon, or wool, or to some damage of the fabric which has been incurred after it has left the mill. Hence it is difficult to draw a sharp line of demarcation. In the following discussion, the above-mentioned broad classification will be used; *i.e.*, all faults not the direct result of processing by the dyer will be placed under the general heading of gray-mill defects; but further clarification will be made in each specific case, fixing the responsibility on the fiber, the yarn, or some other nonmanufacturing condition, as the case may be.

Textile-mill manufacturing operations are, of course, exceedingly complex, and it is not within the scope of this text to review and discuss each mill operation from raw fiber to woven goods, although each such step offers a possible source of trouble in the finished fabric. However, a number of the principal operations to which defects may be traced will be highlighted, with specific illustrations presented.

Since there is a separate chapter on Defects in Man-made Fibers and Yarns, the following comments will refer principally to cotton, except in the manufacturing procedures which are common to all types of fibers.

Raw Cotton

Grade and Character. In dealing with the raw cotton purchased by most mills which do their own spinning of yarns, the

processor is at once exposed to scores of variables which may result in fabric defects. In utilizing any natural fiber, one is faced with many factors which are very much beyond control. The cotton buyer exercises due care and judgment to purchase fiber which meets the particular requirements for his mill; and it is standard practice to classify the cotton according to grade, staple, and character. Of these general headings, the first and last are probably of greatest interest with respect to their influence on the production of defects, since they encompass such important characteristics as "color"—which may range from white to "blue"—foreign matter, and fiber maturity. Cotton which is badly stained or discolored, either through contact with wet leaves or abnormal exposure conditions will very often retain the discoloration right through into the finished goods, especially when they are finished in white or light shades. Foreign matter, too, including particles of leaf and seed, may escape all cleaning processes and fabric scouring and bleaching and may emerge as tiny dark specks in an otherwise perfect piece of fine woven goods.

Included under the general classification of cotton fiber "character" is fiber "maturity"—a quality which may not be readily discernible to the most careful cotton classifier, but which can be detected by laboratory analysis through chemical, microscopical, or dyeing techniques. Without going into details concerning the exact structure and causes of immature or what is often referred to as "dead" cotton, it is important to note that such fibers, apart from affecting the strength of yarns, do not normally come out in processing, either in the weaving mill or the finishing plant, and that they are revealed as undyed or lighter dyeing specks.

Contamination. Starting with the opening of cotton, the hazards to which it is exposed multiply rapidly as the fiber passes through the mill. Every single operation is a possible source of defect through contamination by machine oil; lubricating grease; paint (if maintenance workers are painting in the mill, which is usually the case in one area or another at almost all times); soaps or detergents used during floor-scrubbing operations; clean or dirty water from the condensation of vapors

forming overhead or from leaks from pipes, roofs, or careless splashing; overhead belt dressing; soil from operators' hands; or scores of other sources. If these contaminating agents are non-injurious to the fibers, yarns, or fabric, or if they are removed in normal scouring operations when the goods are finished, they naturally never come to our attention as defects. On the other hand, if they produce physical or chemical damage or resist removal, the finisher cannot help but report them as "mill damage."

In connection with the subject of contamination by foreign matter, it is interesting to call attention to a serious condition which has plagued a number of mills and aroused sufficient concern to result in a thorough investigation by the technicians and research workers in various branches of the industry. A form of damage, commonly described as "tar spots," which appeared in all types of cotton gray and finished goods, was traced to contamination by an asphalt coating used on bale straps to prevent their rusting in the fields. Whenever unhardened or sticky portions of this coating came into contact with the raw cotton where it was not protected by the burlap bagging, they managed to adhere tenaciously through every step or processing procedure. The substitution of a hard-drying, noncontaminating coating on the bale straps eliminated this serious source of damaged goods.

In mills where rayon staple is used, the danger of introducing mixtures of different makes of rayon or different deniers, lusters, lengths, or even different lots of the identical fiber from one manufacturer, having possible variations in finish or dyestuff affinity, is even more prevalent. The problem may be still further complicated when a mill also uses a variety of fibers, such as cotton, rayon, and wool, to produce various blended yarns.

In weave rooms where different types of rayon staple or rayon and cottons are run, a frequent source of trouble is "fly," or contamination by "foreign" fibers' being trapped in the goods during weaving. This condition is especially serious since detecting it is practically impossible until after the goods are dyed. Because viscose and cellulose acetate rayon, cotton, and

wool all dye differently, the dyed goods will reveal these "foreign" fibers in different shades or completely undyed and will require extra dyeing or additional processing to cover up the imperfections.

Accidental Mixing of Materials

One of the most common sources of trouble is the inadvertent mixing of lots of fibers, roving, or yarns which have different properties, weights, or twist. The raw cotton itself may vary in dyeing characteristics from bale to bale, but this is minimized by the usual practice of blending a number of bales in the initial opening and picking operations. Here, as well as in subsequent stages of yarn manufacture, a common procedure is the use of some means of identification of the stock in work, either through the tinting of the material with a fugitive color, which can later be readily removed in the scouring of the goods during finishing, or by the use of some distinctive marking on the package itself, such as colored tops or bands on spools, bobbins, or other holders. Even this system is not without its drawbacks, because there is always the uncontrollable factor of "human error." Besides, many mills have learned too late that certain of their workers are color blind, so that the use of identifying color stains, chalks, and packages has been of no avail.

Faulty Machine Operation

Another constant source of trouble is the careless or faulty operation of some machine, whether it be a variation in the machine speed which alters the product passing through, temperature or humidity changes in the atmosphere which may leave their indelible mark on the raw material, or careless manipulation of temperature or time controls on a machine. Typical examples might be the presence of the wrong gear on a machine, such as the pick wheel on a loom, which results in the fabric's being woven with the wrong number of picks per inch; too high a temperature on a slasher drying cylinder, which overheats the sized warp yarn; too much moisture in the twist-setting chamber; or a marked lack of balance or wobble on a

yarn package, which produces some distortion in the yarn being processed. Apart from the reduced efficiency which may be brought about by mechanical machine stoppage caused by frequent end breakage and the subsequent degrading of woven goods due to excessive knots, the faulty operation through any stage from raw cotton to the spun yarns results in the principal defect of uneven yarn. The general term, "unevenness," may be further described as encompassing such faults as thick places, thin places, slubs, neps, uneven twist, fuzziness.

In the case of yarns which contain more than the ordinary amount of twist—for use in crepes, for example—a "twist-setting" operation is necessary to "kill" or reduce the liveliness of such highly twisted yarn, so as to overcome its natural tendency to kink and snarl when it is later wound or woven. This setting or conditioning process may consist of spraying water which contains a chemical hygroscopic agent directly on to the yarn on warp or filling bobbins, incorporating a mildew-preventive agent; or it may depend on the use of water vapor under controlled temperature conditions in a closed conditioning cabinet. Here, again, careless handling or faulty machine operation which can result in damage to the yarn may be revealed in the finished goods. Some common faults arising from the twist-setting operation are the "fixing" or the transformation of some "fugitive" tints to a nonfugitive form, water stains, and uneven dyestuff absorption resulting from variations in moisture content in the yarn.

Yarn Preparation

Warping. In this operation, during which several hundred ends are laid parallel on a section beam, preparatory to the sizing or slashing for weaving, it is possible to introduce such defects as stretched single ends due to excessive friction or drag as the yarn leaves the package, or chafing due to rough guides or tension devices.

Slashing or Warp Sizing. The application of warp sizing to prevent damage during weaving and to give added strength to weak yarns has often been called the heart of all weaving operations, and any number of fabric faults may be traced to

the slasher room. Excessive drag on one or more section beams may introduce a regular pattern of stretched yarn in the warp of the finished goods. Rolling or crossed warp ends are also possible sources of imperfections. Improper drying, whether it be due to too much heat, causing a baking of the size on the yarn, or insufficient heat or too little time for drying, which results in damp or sticky yarns' being put on the warp beams, can be responsible for serious defects during weaving as well as in the finished fabric. Overdrying tends to produce a harsh or stiff warp and will often be the reason for incomplete size removal during finishing with normal boil-off procedure. Damp yarns will generally have a soft, nonprotective size film, readily damaged by chafing in the drop-wires and harness of the loom, and may also be susceptible to the formation of mildew under certain conditions.

In the case of rayon-yarn slashing, overstretching can result in the production of an inferior piece of woven goods, and overdrying may permanently alter the dyeing properties. A seam on a slasher blanket covering, or a damage to one of the application or squeeze rolls may be revealed as a streak or an imprint in the final woven goods. Localized areas of uneven size pickup due to slasher imperfections may result in hard size spots and subsequent blemishes in the finished fabric. Scum in the size box, oil stains, iron rust, and insoluble copper soap stains formed by the reaction between the copper pipes or size-box lining and free fatty acid in the size mix are all examples of the many conditions which may yield faulty fabric. Certain metallic stains are particularly hazardous, not only because of the difficulty encountered in attempting to remove them in finishing, but also because of the fact that metals such as copper and iron in certain forms act as catalysts in accelerating oxidation during bleaching operations, with the resultant tendering of cellulosic fabrics in those stained areas.

The selection of the ingredients to be used in sizing formulas, especially by mills lacking competent knowledge of chemicals and their reactions, can lead to trouble if they are compounded merely for their results in good weaving efficiency, with no thought of the possibility that they may be quite difficult to

remove in normal finishing operations. When one considers the fact that warp-sizing mixes may contain such materials as starches, gums, gelatins, penetrating agents, softeners, starch stabilizers, and mildew preventives, each including a whole range of products in its own category and having an almost infinite number of properties, and that two ingredients which are incompatible might be used in the same solution, it is evident that this is no field for the experiments of a novice who has no technical training or experience. The problems of warp sizing, like those of dyeing and finishing, have been made more difficult by the introduction of the many man-made fibers, with their multitude of variable physical and chemical characteristics, and the development of new chemical compounds whose reactions with fibers and boil-off and finishing agents are not completely known or understood.

Improper slashing is often the controlling factor in poor weaving. Excessive end breakage in the loom, chafing in the harness, drop-wires, and reed, size shedding, and damage by the shuttle are only a few of the difficulties often traced to poor warp sizing. With the exception of the broken ends, which cause a reduction in weaving efficiency as well as excessive knots, most of these defects are latent and do not reveal themselves until the goods are dyed and finished—a fact which makes the problem particularly serious. In the case of continuous-filament rayon warps, chafing in the loom brings about the condition commonly known as “fuzz balls,” in which the fine filaments are rolled up into tiny bunches, or balls, accumulating in the reed or the drop-wires and causing frequent loom stops and end breakage.

Weaving

Weaving, while it has been basically unchanged over the centuries in its process of interlacing warp and filling yarns to form a piece of cloth, is generally conducted today on high-speed looms, which are no longer simple machines, but complex pieces of equipment with automatic mechanical and electrical controls—machines which are precision-built and which re-

quire fine adjustment and constant, careful maintenance to keep them operating efficiently.

Warp Imperfections. Following the slashing and placing of the warp yarn on loom beams comes the process of drawing in the single ends through the heddles of the harnesses, according to the pattern prepared by the designer. The most common error which may occur at this stage is a "wrong draw," or the drawing in of an end or a series of ends in improper sequence or position, which would alter the weaving in that area and cause a distortion of the pattern—two ends weaving as one, for instance. The warp ends then pass through the reed, which is essentially a comb having a series of equally spaced flat metal wire "teeth," the number of "dents" per inch or the spaces between the wires being specified according to the type of fabric that is being woven. Principal imperfections originating from the reed may be enumerated as (1) chafing due to rough metal edges; (2) rust or grease stains from tarnished or dirty reeds; and (3) variations in spaces between the warp ends of the woven fabric due to damaged or weak reeds.

The uneven spacing of warp ends caused by damaged reeds is the usual cause of so-called "reed marks," with one or more warp streaks running through full pieces and very little chance of their being eliminated through any manipulation in dyeing and finishing. The ratio of "air space" to "reed-wire space" is particularly important in the case of rayon fabrics, since a high ratio can result in poor support to the reed wire or a weak reed, which is readily bent or otherwise damaged, whereas a low ratio necessitates too much crowding of the yarn ends in the space available, with resultant chafing, regardless of how well the warp may be sized.

Other imperfections which may appear in the warp are tight or overstretched ends, slack ends, or "strip-backs." The last-mentioned is the term used to describe the defect caused in a plied yarn, as for example, in a combination yarn of viscose-rayon crepe and acetate rayon, in which one of the yarns—usually the acetate—has been broken and is bunched up or missing for some length.

Harness skips, in which the warp and filling yarns are inter-

laced in some order other than the normal pattern, may be due to the harness's being dirty or being set too low, or may be caused by broken heddles. Patterning, or repeat marks in the weave, is sometimes caused by uneven harness tension. Improper timing adjustment is frequently responsible for the "thin" or "hungry" appearance of woven fabrics described as having "poor cover."

Filling Imperfections. Stretched yarn, unremoved tint, and lack of yarn uniformity in size or twist are frequent causes of short sections of filling streaks. Full bobbins of mixed filling yarns are usually responsible for complete bands of different appearance or color running from shuttle change to shuttle change. Certain damages to filling yarn may be inflicted by faulty filling-fork stop motion. Broken picks or filling threads may be traced to sharp feeler motions, rough shuttle boxes, or cut shuttle eyes or yarn guides; also, to the shuttle's not entering the box in proper alignment. Filling kinks or uneven or loopy selvages are usually attributed to waste accumulation behind the drop-wires, to insufficient tension on the yarn, or to the filling's having caught on the shuttle. Double picks, or two picks weaving as one, are generally the result of improper harness action. Improper operation of the shuttle feeler can be responsible for loopy selvages or pulled-in or "jerked-in" filling.

Take-up rolls which are untrue, or faulty take-up motion, or maladjusted let-off motion are likely to produce the common defect of "uneven pickage." A similar condition, caused by loom stops, is known as "set marks," in which the pickage is generally higher than normal. These pickage variations are not always easy to detect in the gray state and will not be noticed until the goods are dyed and finished, the uneven penetration of dyestuff then resulting in the appearance of narrow bands where the fabric is denser.

Miscellaneous Damages

Temple Marks. Temples on the loom are used to hold the cloth to its proper width, gripping it in front of the reed for a distance of about 4 in. on either edge. Although the old pin-type rollers have been generally replaced by temple rolls covered

with some other type of gripping surface, such as rubber or composition, to prevent slippage without piercing or cutting the fabric, even this type may be a source of damage to the gray goods before it leaves the loom. For example, eccentric rolls may cause a distortion in some constructions which will be difficult to correct in finishing. Again, a faint warp streak may be introduced by a slight shifting of the warp yarns or an almost imperceptible chafing if the temple rolls grip too tightly. In the case of helical spiral-type rubber covering, a distinct pattern will be permanently impressed on some fabrics, taking the form of short, diagonal streaks.

Shuttle and Box Marks. Shuttle marks, or the chafing of warp yarn by the shuttle's striking the warp, may be traced to improper shed opening, to maladjusted picking which causes a rebounding of the shuttle, to a damaged shuttle, or to an inadequate or worn plush covering on the race plate. It is assumed, of course, that the warp sizing is adequate in providing a firm protective film on the warp yarn, to withstand any slight normal abrasion in the weaving operation.

"Box marks" are from the chafing of filling yarn as it sloughs off the bobbin and is trapped under the shuttle.

Sand-roll Cuts. Another cause for damage is the use of coverings on the take-up rolls which may injure the fibers or the yarns, particularly in the case of woven rayon fabrics. Years ago, it was common practice to use, as covering for these "sand rolls," perforated tin or coarse sandpaper; and a common defect, again not noticeable until the goods were dyed and finished, was that of sand-roll cuts, on rayon fabrics in particular. The fine, razorlike cuts are almost impossible to detect in the gray goods, but the fillingwise tension exerted during wet processing pulls apart the partially severed filaments with disastrous results. Cotton mills, not thoroughly familiar with the many hazards involved in converting to the weaving of delicate rayon yarns, were usually the chief offenders; but the modern weave-room practice of using rubber or cork rolls has reduced this defect to a minimum.

Creases. Hard creases in fabrics may be introduced on the loom through careless take-up, or even in later operations, such as inspection and re-rolling of the goods without the use of

proper spreader bars, or through jerky unrolling and re-rolling. Another source of creases in the gray may be tight selvages. In certain constructions these creases are impossible to remove in wet processing and they show up as dye streaks.

Selvages. Selvages can be extremely troublesome, especially in rayon constructions. If they are too heavy, they are likely to build up on the loom or, in some cases, on the dye jigger if they are processed in the open width, and the result is a finished piece with a stretched or baggy condition in the center. Again, tight selvages, which are a constant source of annoyance to the dyer, may cause oblique dye streaks running out of the selvages or may show as broken or torn selvages if the strain is excessive. Even if the goods are dyed perfectly, it is sometimes found that they will not lie flat on the cutting table. Abnormally loose selvages, too, are undesirable and are likely to result in poorly dyed or poorly finished cloth.

Damage to Woven Fabrics

After the cloth has been woven, there are comparatively few opportunities for introducing imperfections; but there still remain such dangers as staining by water or dropping paint, cutting or tearing on the shearing machine, insect or mildew damage, spot-washing stains, and such simple mechanical damage as nail holes for which carelessness in the nailing of packing cases is to blame. Of course, gray goods in transit, like any other product, can be damaged by water, chemicals, or ordinary rough handling.

The foregoing, while it gives by no means a complete description of every defect which may be introduced in the gray mill, presents a general idea of some of the more frequently occurring conditions which will result in the degrading of a piece of finished fabric.

While there is some duplication of faults recorded in both cotton and spun-rayon fabrics, merely to emphasize the fact that they are common to both fibers, the following case histories have been separated into one group composed of all-cotton fabrics and another of all-rayon or rayon-and-cotton constructions.

CASE 1-1. WARP STREAKS

Fabric

Three-leaf cotton-twill suiting

Construction

Count: 106×56

Warp: 36/2 combed cotton

Filling: Same as warp

Finish

Plain dyed khaki

Defect

Numerous single warp streaks present across the entire width of the goods and running continuously throughout each piece. General appearance was one of uneven luster rather than a difference in color or shade.

Analysis

As indicated above, the warp yarns in these goods were supposed to have been two-ply 36's cotton. Analysis of a large number of consecutive ends taken from the fabric showed wide variations in the size of the single yarns. Actual size range was from 32's to 43's, with the twist varying from a low of 16 turns per inch to a high of 30 turns per inch. The ply twist was also very irregular, running from as low as 14.3 to as high as 17.6 turns per inch. The variations in yarn size and twist resulted in differences in light reflection, producing the streaky warp appearance. In this particular case, the yarns had been purchased by the weaving mill from a commission yarn spinner, who eventually assumed all responsibility.



FIG. 1a. Uneven yarns in fabric.

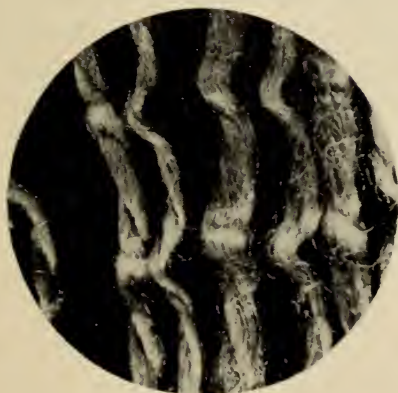


FIG. 1b. Uneven plied yarns.

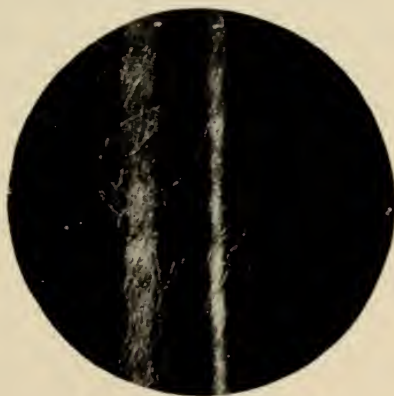


FIG. 1c. Uneven single yarns.

CASE 1-2. RIPPLED EFFECT

Fabric

Cotton-twill raincoat fabric

Construction

Count: 96×60

Warp: 30/1 combed cotton

Filling: 40/1 combed cotton

Finish

Plain dyed olive drab

Defect

Peculiar rippled effect in the filling, starting and stopping at shuttle changes

Analysis

It was found that the filling yarn in the faulty-appearing sections was finer than normal with somewhat more twist. The single yarn sized 60/1 with 17.8 turns S, as compared with 39/1 and 15.1 turns S in one of the normal bands. Although laboratory wetting out and hand ironing restored the normal appearance in the faulty sections, the defect was attributed to the off-size filling yarn, which caused differences in compressive warp shrinkage in those places during Sanforizing.

CASE 1-3. YELLOWING OF COTTON

Fabric

Print cloth

Construction

Count: 64×60

Warp: 28/1 carded cotton

Filling: 40/1 carded cotton

Finish

Gray goods

Defect

Certain pieces of all-cotton print cloth gray goods were found to yellow on being subjected to heat in connection with their use for special industrial purposes by a rubber company.

Analysis

Laboratory tests showed that, although any of this cotton fabric tended to yellow when subjected to high temperatures in the gray state, some pieces which yellowed more than others came from a different mill and had been sized with a slightly different formula. The pronounced discoloration on heating was attributed to the tendency for certain warp-sizing ingredients to yellow more readily than others when too much heat was applied. Since the warp-sizing materials were considered of good quality and had no harmful effect on the goods when desized and used for other purposes, the gray mill felt justified in not assuming any responsibility for color change which took place in this particular application.

When a customer's requirements are such that special precautions must be taken in the selection of warp-sizing compounds, specifications should be indicated on the purchase order.

CASE 1-4. THIN SPOTS

Fabric

Napped all-cotton soft-filled sheeting

Construction

Count: 44×36

Warp: 20/1 carded cotton

Filling: 13/1 carded cotton

Finish

Plain dyed tan and napped

Defect

Thin, weak spots scattered through several pieces

Analysis

Tensile-strength tests confirmed the fact that the thin-looking spots were weak in the fillingwise direction. Examination showed that the filling yarns were very uneven and that, in the napping process, the thin yarns were frequently ruptured, with resultant open-appearing and tender areas.

In this case the seller of the gray goods was aware of the fact that the fabric was intended for napping by the converter. Since earlier deliveries and most of the pieces processed in the same lot gave no trouble, the customer's complaint was recognized as justifiable.

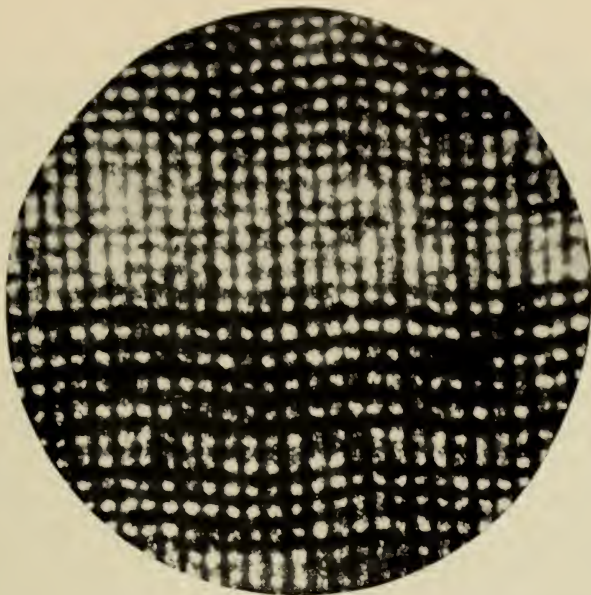


FIG. 2a. Thin spots due to broken filling yarns (transmitted light).

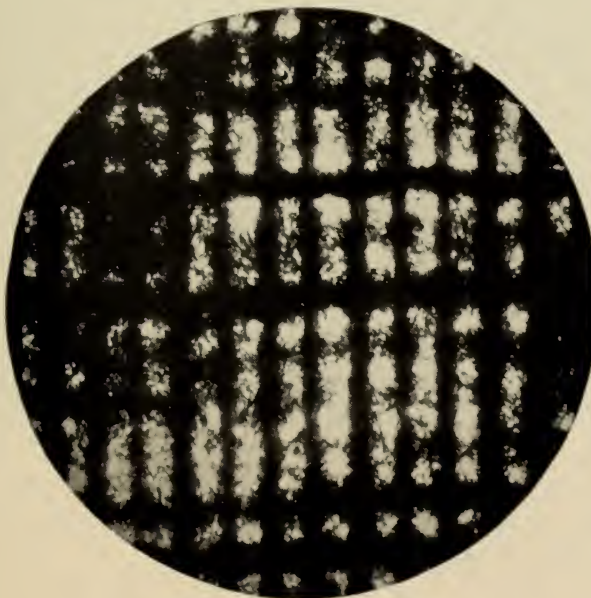


FIG. 2b. Same at higher magnification.

CASE 1-5. FILLING BANDS

Fabric

Cotton brassiere cloth

Construction

Count: 144×84

Warp: 100/2 combed cotton

Filling: 90/3 combed cotton

Finish

Plain dyed peach

Defect

Light and dark filling shade bands

Analysis

Analysis showed that the shade bands were actually an optical illusion caused by variations in pickage or set marks in the weaving. In the light-appearing sections there were 25 picks per $\frac{1}{4}$ inch, whereas in the darker adjacent $\frac{1}{4}$ inch there were only 20 picks. Where the pick count was high, the dyestuff penetration was less and there was a very narrow light band. This band was never more than about 1 inch in width, the pick counts gradually returning to the normal. To prove that the apparent shading was an optical effect, small cuttings from the light and dark bands were removed about 2 inches from the distinct shade change and substituted for each other. The shade match was perfect, showing no difference existent beyond the narrow section where the pick count was abnormal. Such set marks, or starting-up places, are fairly common in some constructions and may be due to faulty loom take-up or let-off, or to a sagging of the warp during exceptionally long periods of its standing with the shed open.

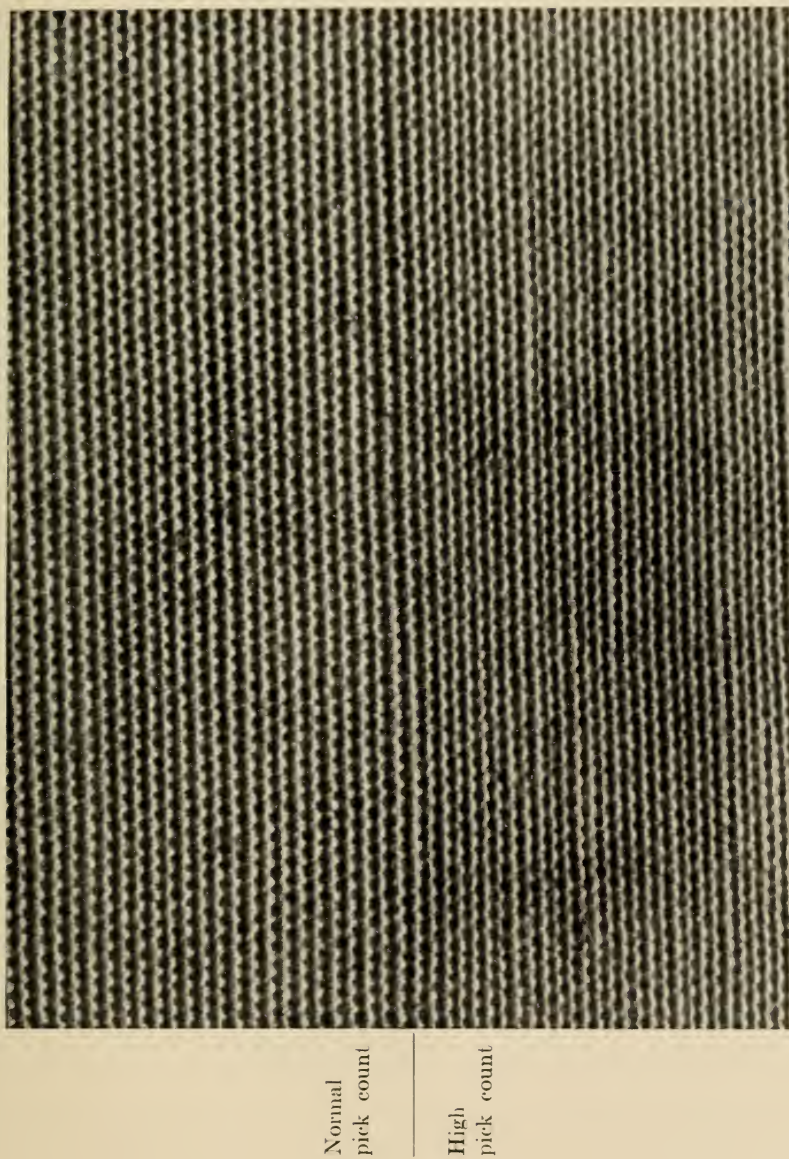


FIG. 3. Band due to pickage variations.

CASE 1-6. WARP STREAK

Fabric

Slub shirting broadcloth

Construction

Count: 120 \times 64

Warp: 40/1 combed cotton

Filling: 36/1 cotton slub yarn

Finish

Plain dyed light blue

Defect

Narrow warp streak throughout piece

Analysis

The dark-appearing streak in this fabric was found to be due to a cracky open place in the warp, apparently caused by a damaged reed.

As in the case of many other fabric defects, the degree or intensity of this type of imperfection may vary greatly. In some cloth constructions a slight "reedy" condition in the gray goods may be so minimized in finishing that an experienced inspector in the weaving-mill cloth room would be justified in passing the goods as first quality. The example described in this instance, however, as disclosed in the accompanying photomicrograph, is typical of an extreme condition which would normally be detected and classified as a "second" by the mill.

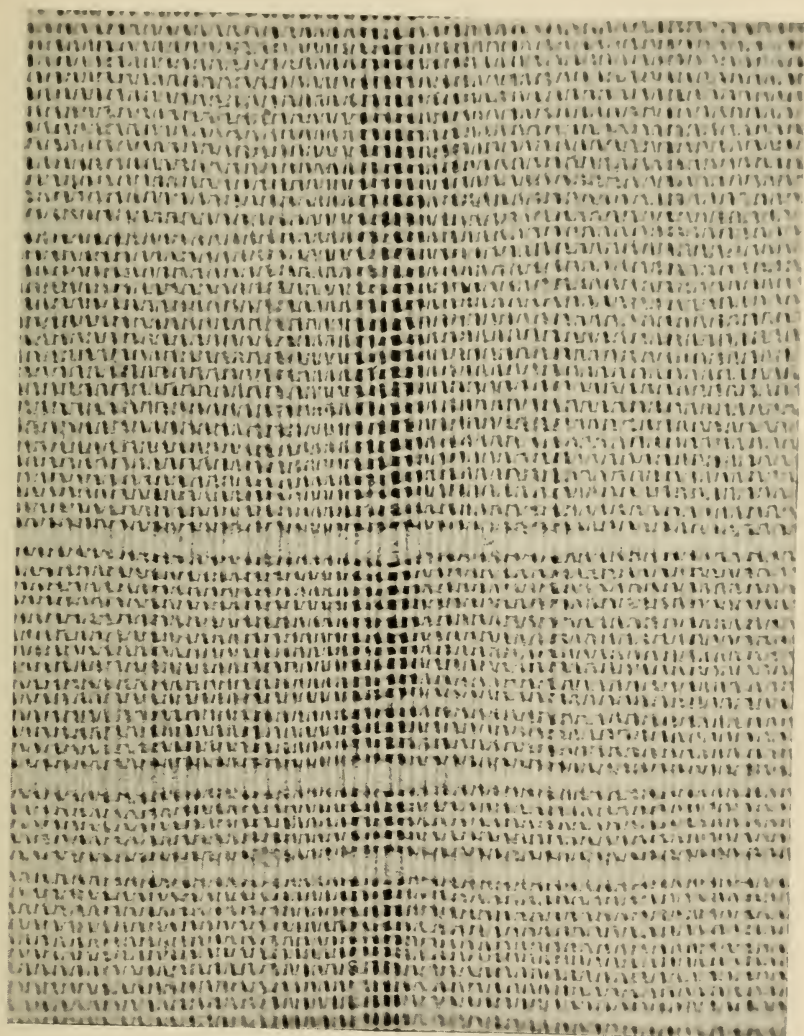


Fig. 4. Streak due to reed mark.

CASE 1-7. FILLING STREAKS AND SLUBS

Fabric

Chambray dress goods

Construction

Count: 84×76

Warp: 40/1 cotton (wine)

Filling: 40/1 cotton (white)

Finish

Bleached and Sanforized

Defect

Filling streaks and slubs of varying lengths

Analysis

Examination showed that the streaks were due to thick and thin places and excessive slubs in the filling yarn. The unevenness of these yarns was confirmed by the weighing of short sections, as well as by examination of several yards removed and wrapped on a blackboard by a hand seriplane. By actual measurement, the yarn was found to vary from as fine as 51/1 to as heavy as 37/1 within 1 yard. This defect was attributed to a poor quality of filling yarn, particularly detrimental to the appearance in a chambray of this type because of the greater contrast between the white and the dyed yarns.

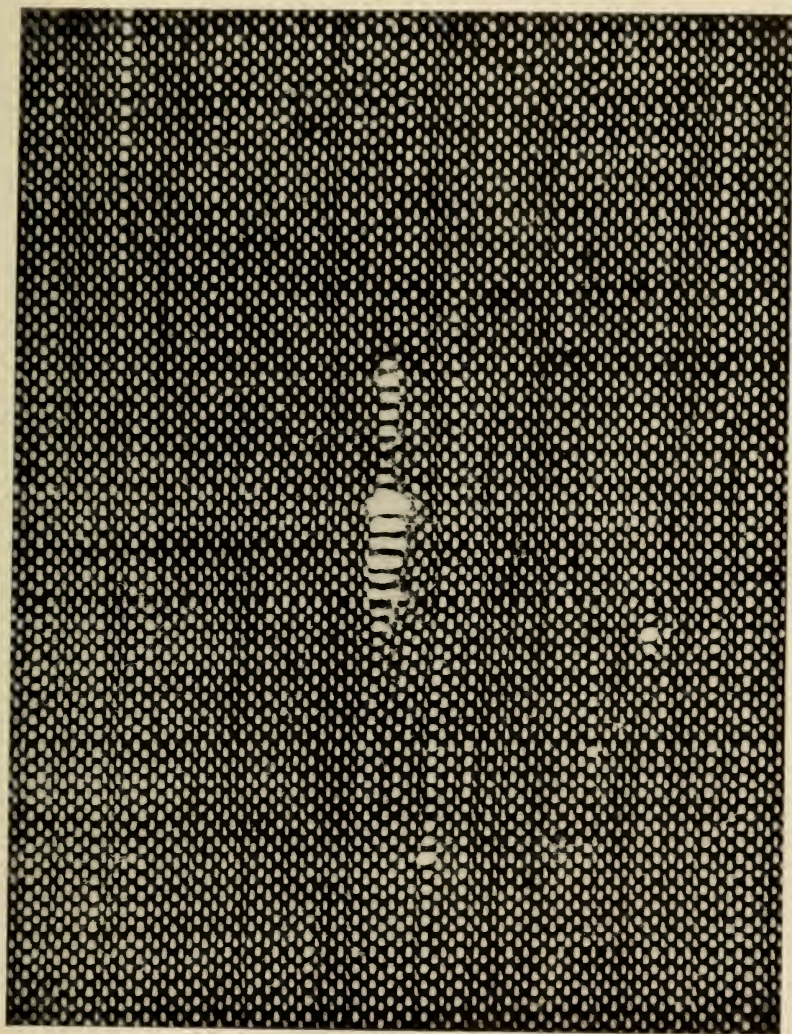


FIG. 5. Poor quality filling yarn.

CASE 1-8. WARP STREAKS

Fabric

Cotton-twill suiting

Construction

Count: 106×52

Warp: 26/2 combed cotton

Filling: 30/2 combed cotton

Finish

Plain dyed khaki

Defect

Numerous short, light warp streaks

Analysis

Physical tests showed no abnormal construction or yarn composition fault which could be responsible for this defect. Examination under ultraviolet light, however, showed a marked fluorescence in the streaky sections, indicating traces of unremoved mineral oil. This defect appeared to be due to portions of the warp yarn's being badly stained with mill oil or grease. In the dyeing and finishing, the dirt was evidently removed, but enough of the oil remained to act as a resist in dyeing.

CASE 1-9. STAINS

Fabric

Dress goods

Construction

Count: 104 × 76

Warp: 33/1 carded cotton

Filling: 40/1 carded cotton

Finish

Plain dyed light blue

Defect

Irregular blotches throughout the piece

Analysis

Examination of the full piece showed the presence of randomly distributed blotches dyed lighter than the balance of the piece. It was observed that many of the stains were around dirty warp or filling yarns or in areas where there appeared to be weaving imperfections which might have resulted in soiling of the fabric. Evidently the goods had been spot-washed in the gray mill. Inspection of several pieces of gray goods showed them to contain similar stains. Laboratory desizing and scouring of the gray-goods cuttings apparently eliminated these stains, but upon dyeing, they reappeared as lighter colored resist spots. Investigation disclosed that the gray goods had been held for more than 8 months before finishing. Finishers who kier-boiled these goods prior to bleaching reported no difficulty. It was concluded that the spot-washing compound underwent some changes on aging which made spots difficult to remove unless kier-boiling was used as standard procedure in finishing.

CASE 1-10. HOLES

Fabric

Cotton sheeting

Construction

Count: 80×92

Warp: 28/1 carded cotton

Filling: 36/1 carded cotton

Finish

Desized and singed

Defect

Small holes across width of piece at irregular intervals

Analysis

Examination showed that, wherever the small holes were present, there were thin places in the fabric resulting from set marks, or loom starting-up places, where the pickage was much less than the normal. When goods containing this kind of imperfection are singed in the finishing plant by passing them over open gas flames, there is the danger of the flame's shooting through the more open places and burning small holes in the cloth. It was noted that there were brownish scorched areas around the holes, which confirmed the fact that the damage was produced by burning.

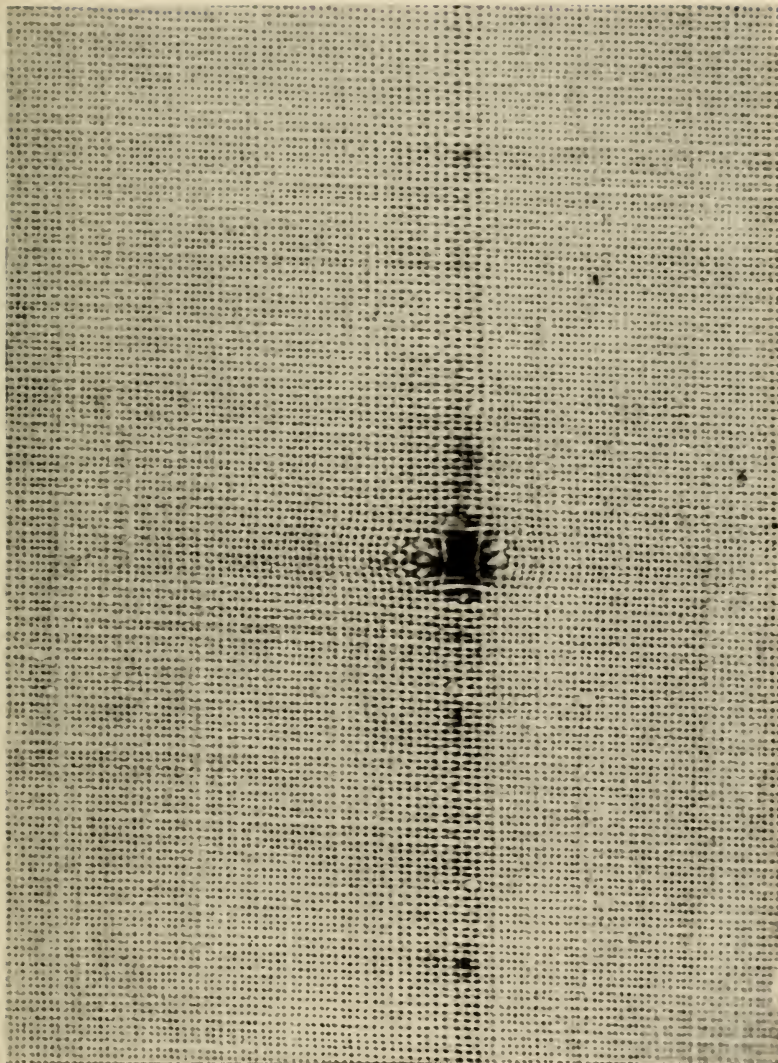


FIG. 6. Singe holes due to thin places in filing.

CASE 1-11. FLOATING ENDS

Fabric

All-cotton napped cord suiting

Construction

Count: 140×76

Warp: 38/1 cotton

Filling: 40/1 cotton

Finish

Suede finish, plain dyed tan

Defect

Floating ends throughout several pieces

Analysis

Analysis showed that, whenever the defect appeared, there were several wrong draws in the goods. In some places as many as three ends were found weaving as one. In the sueding (napping) operation, the picks were sufficiently weakened in these places to break through and allow the warp ends to float loosely on the surface.

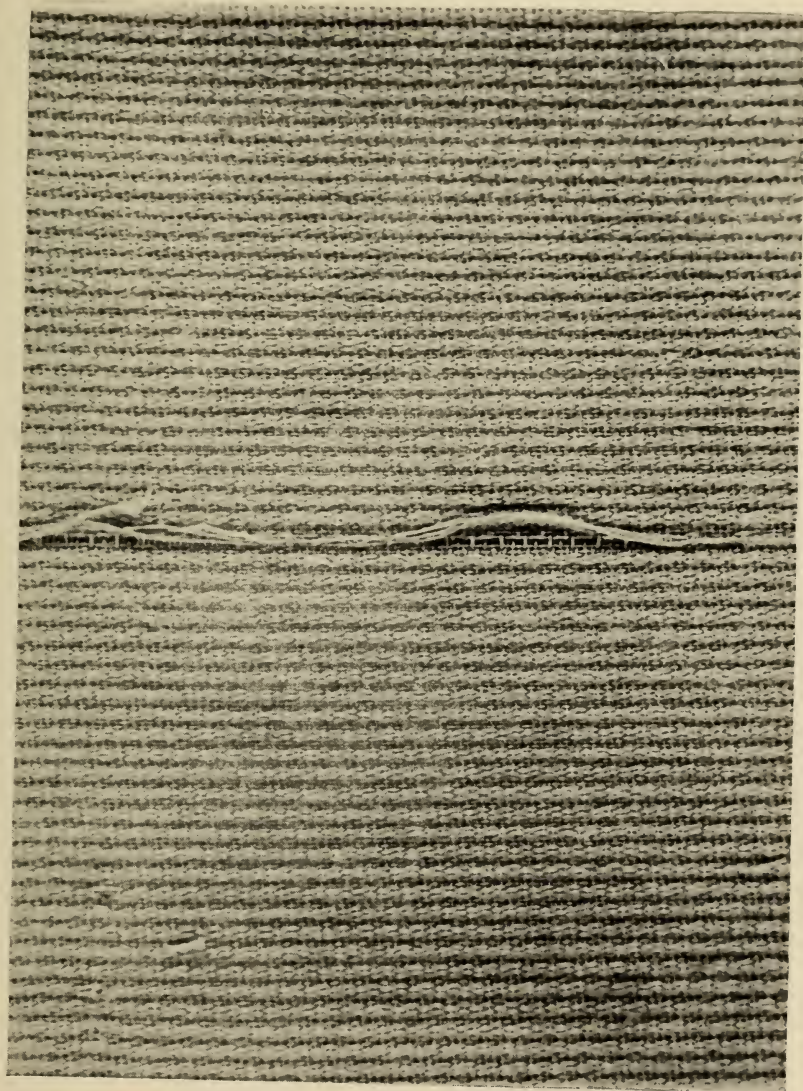


FIG. 7. Ends improperly woven and broken out during napping.

CASE 1-12. WHITE SPECKS

Fabric

Gabardine suiting

Construction

Count: 107×58

Warp: 36/2 combed cotton

Filling: 24/2 combed cotton

Finish

Plain dyed light blue

Defect

Numerous white specks in filling only

Analysis

Examination showed that the spots were confined to the filling yarns except in a few instances, in which there appeared to have been some transfer to the warp yarns. Tensile-strength tests made on a number of the filling yarns in those places showed them to be considerably weaker than similar yarns in other parts of the same piece, the breaks always occurring at the white specks. Chemical tests revealed the presence of traces of iron around the edges of the spots. It was concluded that the defect was due to contamination of the filling yarn by spots of oil which contained small amounts of iron originating from a bearing and carried by the lubricating oil onto the yarn. In subsequent bleaching of the goods prior to dyeing, the iron acted as a catalytic agent in producing overbleaching. The resultant oxycellulose which was formed is low in tensile strength and is also more resistant to dyeing than are the normal, undamaged fibers.

CASE 1-13. COLOR BLEEDING

Fabric

Colored-yarn shirting

Construction

Count: 104 × 60

Warp: 40/1 yarn-dyed cotton (blue with red stripe)

Filling: 40/1 cotton (white)

Finish

Plain Sanforized

Defect

In the finishing of this fabric, it was found that one of the red stripes near each selvage bled and stained the adjacent ends.

Analysis

Analysis showed that a single red-dyed end in the stripe nearest each selvage was composed of bright spun-viscose rayon instead of all cotton. Chemical tests showed that the rayon had been dyed with commercial direct dyestuff which was not fast to washing. This defect was obviously due to a mixing of yarns at the mill where they had been running dyed all-rayon yarns, as well as fast-dyed cotton yarns. The dyed rayon yarns were satisfactory for the particular constructions for which they were normally used, since the all-rayon goods were not being sold as washable, and the normal finishing operations would have been much less severe than those used on all-cotton shirting cloth.

CASE 1-14. HOLES

Fabric

Cotton dress goods

Construction

Count: 92×92

Warp: 30/1 combed cotton

Filling: 40/1 combed cotton

Finish

Plain dyed navy

Defect

Small holes near one selvage and extending in for about 4 inches from the edge

Analysis

Examination of the sample submitted showed that both warp and filling threads were punctured throughout the entire piece. The series of small holes was attributed to damage by the coarse or dull pins on a wooden temple roll used on the loom. In recent years this type of temple roll has been replaced by rolls covered with rubber or other surfaces, which grip the fabric without the danger of cutting by the metal pins, particularly after they tend to become dull.

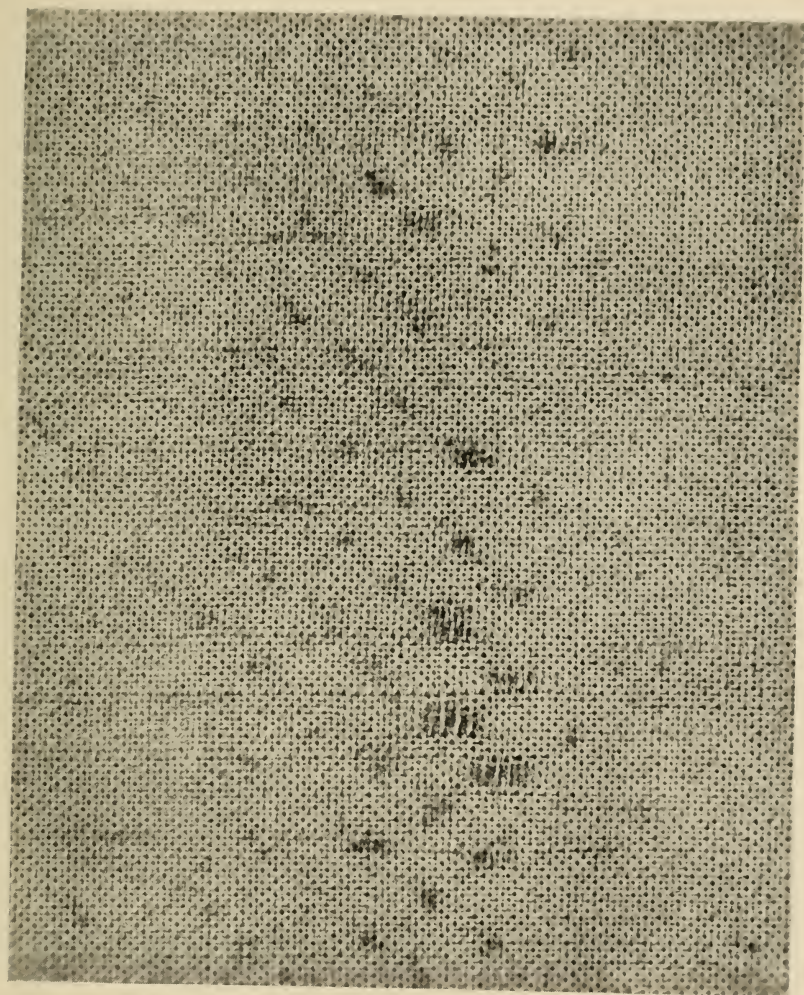


FIG. 8. Damage caused by temple roll pins.

CASE 1-15. BLACK SPOTS

Fabric

Cotton sheeting

Construction

Count: 68×72

Warp: 30/1 carded cotton

Filling: 40/1 carded cotton

Finish

Bleached plain white

Defect

Occasional black spots

Analysis

Microscopic and chemical analysis showed the black spots to be a tarlike deposit, apparently imbedded in the yarns. When warp and filling threads were unraveled in several places, it was found that the yarns contained slubs in those places, indicating that the tarry material was present in the raw cotton and prevented the proper drafting of the yarns. It was subsequently determined that this condition was being encountered in a great many cotton mills, and the contamination was traced to the black asphalt-type paint used on the cotton-bale straps. In the application of this paint, if the consistency is too thick in places, it does not dry thoroughly and parts of the sticky compound stain and adhere to any cotton with which they come in contact. It should be noted that some similar black stains in cotton fabrics have been traced to roof leaks or belt dressing and that only a chemical analysis can be relied upon to trace such stains to their true source.

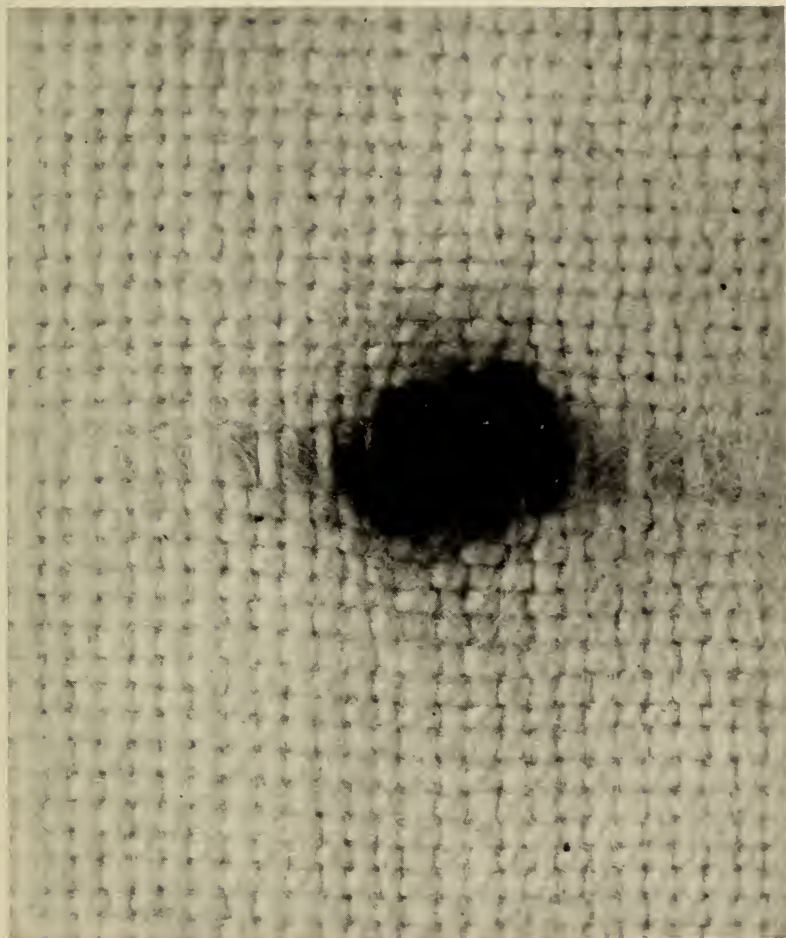


FIG. 9. Asphalt stain in cotton sheeting.

CASE 1-16. WARPWISE FLOATS

Fabric

Chambray dress goods

Construction

Count: 80×72

Warp: 40/1 combed cotton, alternate ends dyed aqua

Filling: 40/1 combed cotton (white)

Finish

Plain bleached and preshrunk

Defect

Warpwise "floats" along one edge of a full piece

Analysis

Examination showed that the floats ran in a straight line throughout the full piece at a distance of about 3 inches from one selvage, repeating at approximately 2-inch intervals. The floats were found to be due to the cutting of single picks in the faulty areas. From the nature of this defect, it was attributed to damage during weaving, probably produced by a faulty temple roll.

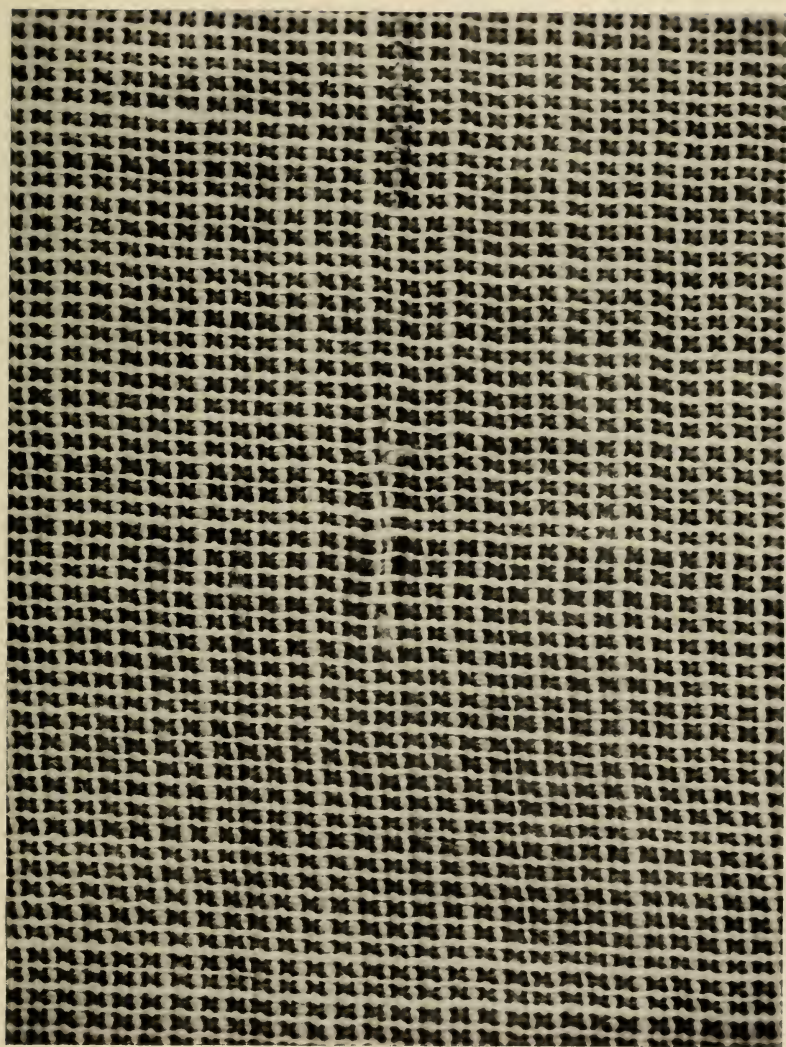


FIG. 10. Floats due to cut filling yarn.

CASE 1-17. WARP STREAKS

Fabric

Napped cotton soft-filled sheeting

Construction

Count: 44×36

Warp: 20/1 carded cotton

Filling: 13/1 carded cotton

Finish

Plain dyed camel and napped

Defect

Warp streaks near one edge of fabric

Analysis

Examination of a cutting from the piece submitted showed that the warp streaks were due to differential napping of the surface. The streaks were visible on both the face and the back of the cloth. By microscopic analysis it was found that the warp yarns were unevenly spaced in those areas in a fairly regular pattern. Where the ends were closer together, the filling was apparently bound more tightly and resisted the napping. The uneven spacing of the warp yarns was due to a faulty gray-goods condition, which probably would have showed up as warp streaks in the dyed goods before napping, but the latter operation accentuated the condition.

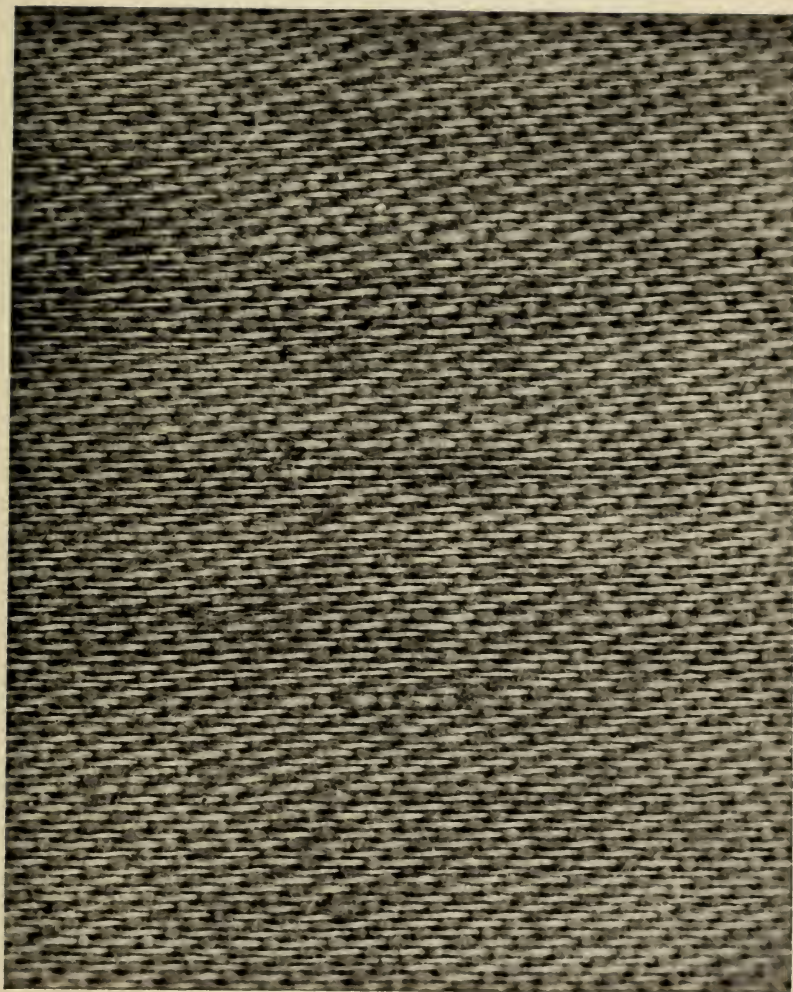


FIG. 11. Back of napped cloth showing reedy appearance.

CASE 1-18. WHITE SPECKS

Fabric

Printed cotton dress goods

Construction

Count: 68×72

Warp: 23/1 carded cotton

Filling: 21/1 carded cotton

Finish

Navy-ground blotch print

Defect

Numerous white specks throughout the printed areas

Analysis

Careful inspection disclosed the fact that the white specks were places that the print color had not penetrated. Upon further examination, it was found that the fabric contained an excessive amount of small neps of cotton which were readily dislodged from their original position but, in many cases, still adhered to the cloth surface. Microscopic examination showed that these cotton neps were composed of dead or immature fibers. Apparently the printing was commercially satisfactory, but in the normal soaping as part of the finishing process, the neps were loosened or moved sufficiently to expose the uncolored areas under them. While extra preparation of the gray goods might have minimized the presence of these small bunches of immature cotton fibers, it was concluded that the defect was due to the use of an extremely poor quality of cotton, which was not suitable for printing.

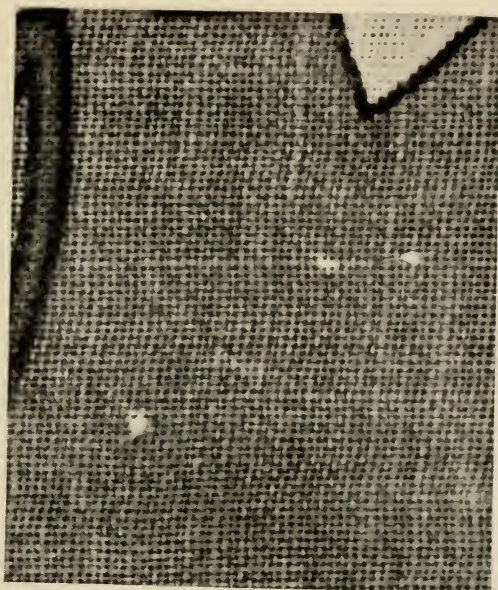


FIG. 12a. White specks in printed fabric.

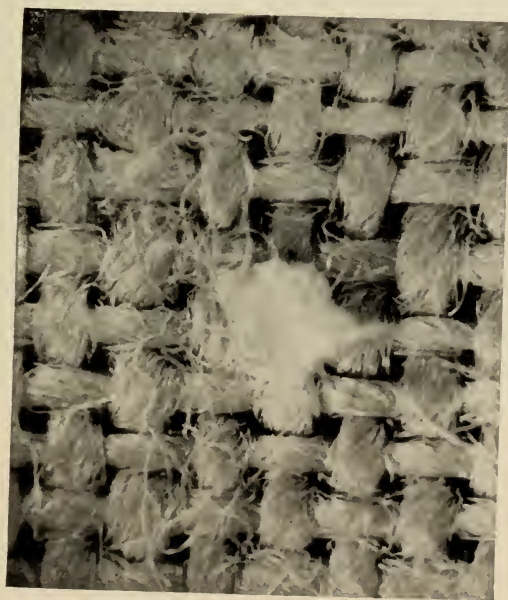


FIG. 12b. Cotton nep dislodged after printing.

CASE 1-19. WARP STREAK

Fabric

Striped dress goods

Construction

Count: 96×72

Warp: 40/1 combed cotton (brown) and cord made up of two ends of 20/2 combed cotton (white)

Filling: 40/1 combed cotton

Finish

Plain preshrunk

Defect

Single dark warp streak near the center of the piece

Analysis

Analysis showed that one of the white cords contained an end of 37/2 cotton and that an adjacent cord was composed of 50/3 yarns. Since these two composite yarns were finer in diameter than the normal specified 20/2, the adjoining brown ground stripes appeared to be wider in proportion and resulted in the streaky appearance.

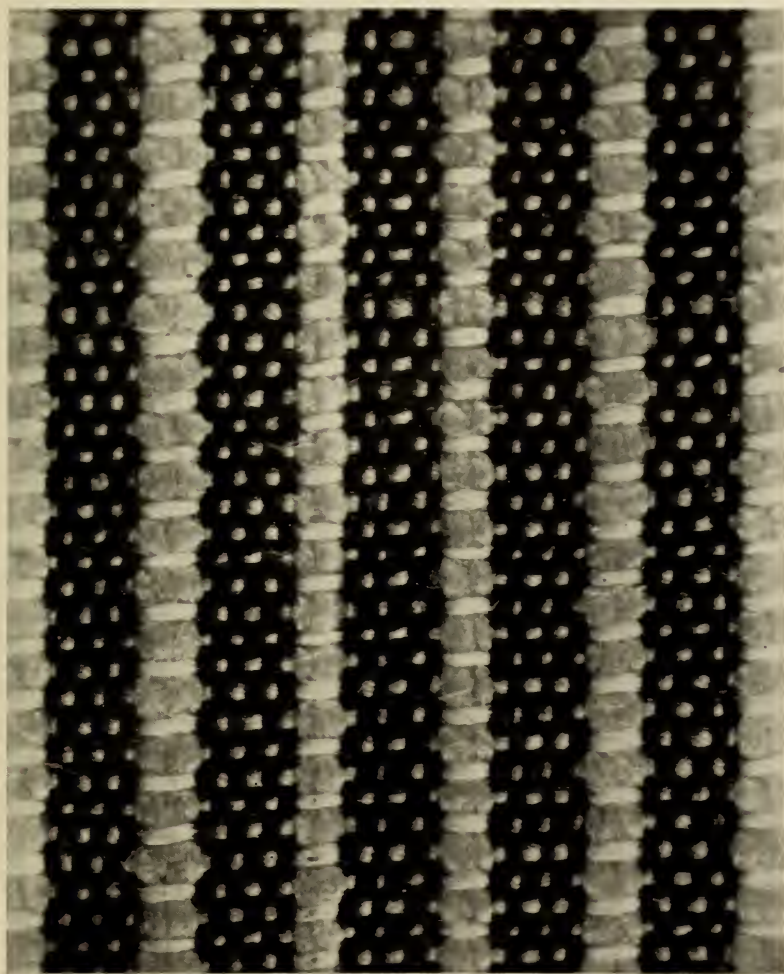


FIG. 13. Streak due to fine cotton ends.

CASE 1-20. FILLING BAND

Fabric

Chambray dress goods

Construction

Count: 96×92

Warp: 50/1 cotton (blue)

Filling: 50/1 cotton (white)

Finish

Plain preshrunk

Defect

Light filling band

Analysis

Examination showed that the band began at a knot and ended at a shuttle change. The filling yarn which produced the light band effect sized 32/1, instead of 50/1 as specified.

This defect was evidently due to mixing of yarns at the mill since it was learned that they were also running 30/1 yarn at the time these goods were woven.

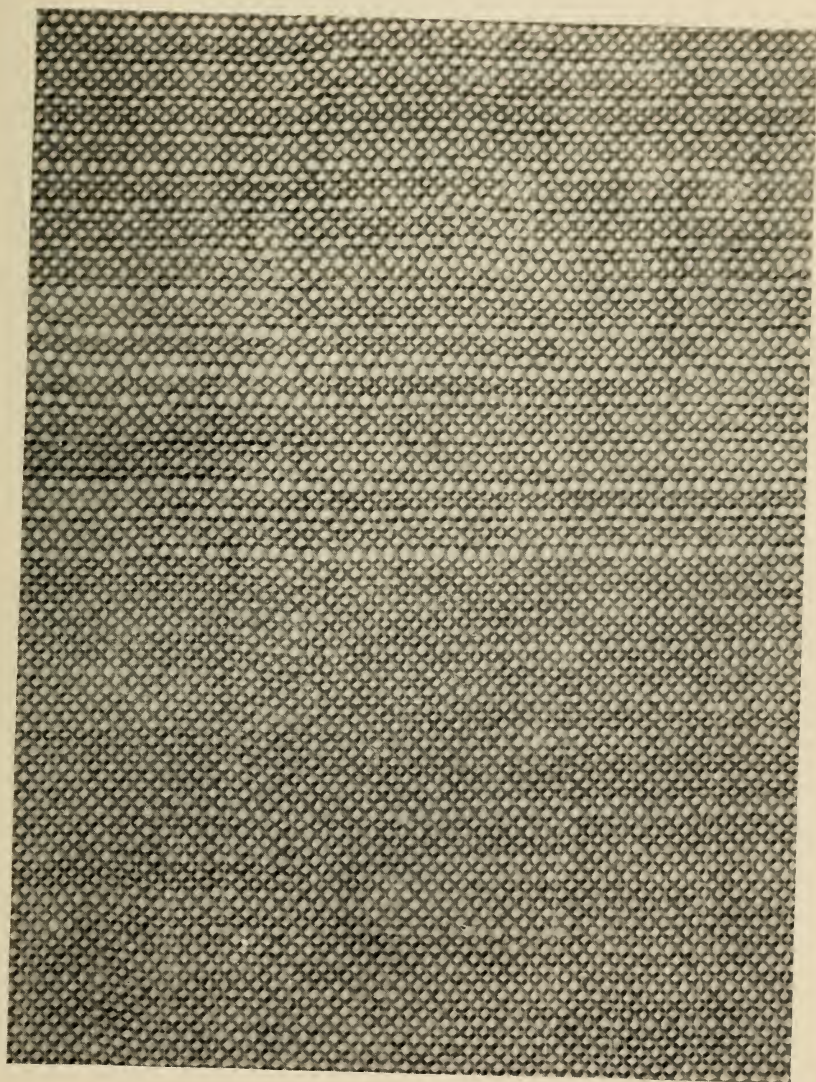


FIG. 14. Light band due to off-size white filling yarn.

CASE 1-21. WARP STREAKS

Fabric

Five-harness-warp sateen

Construction

Count: 102×100

Warp: 60/3 combed cotton

Filling: Same as warp

Finish

Gray goods

Defect

Warp streaks throughout several pieces

Analysis

Analysis disclosed the fact that the warp streaks in the sample submitted were due to the presence of a number of plied ends with abnormally high twist (up to 40 turns, instead of the normal 20 turns per inch).

The highly twisted yarns were thinner in diameter than the normal warp ends and resulted in the appearance of warpwise cracks or streaks.

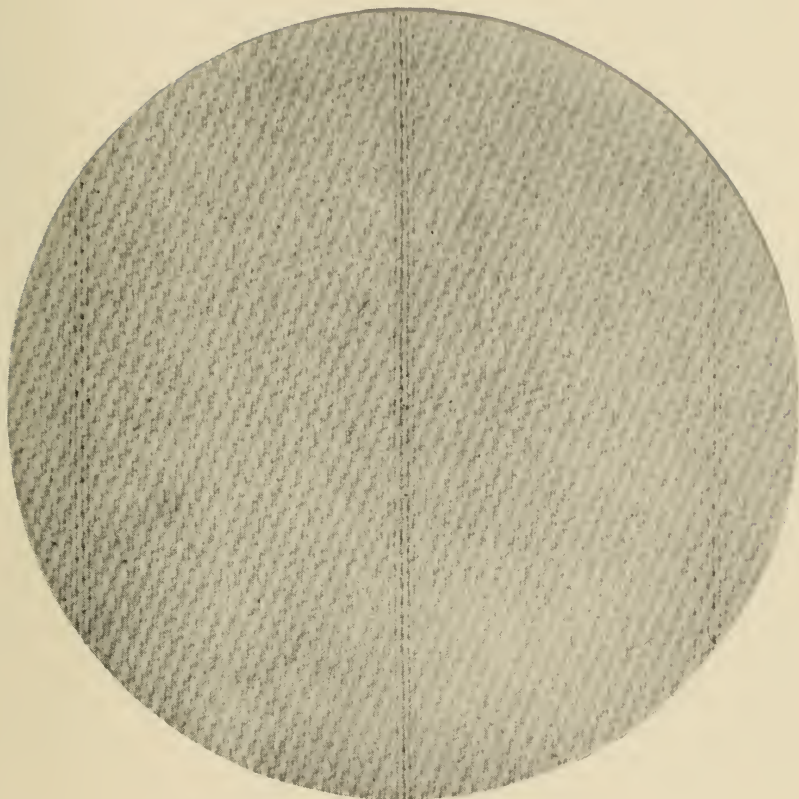


FIG. 15. Streak due to high-twist yarn.

CASE 1-22. FILLING STREAKS

Fabric

Rayon-satin foundation-garment fabric

Construction

Count: 300×64

Warp: 150/40 bright viscose rayon

Filling: 60/1 cotton with core of cut rubber

Finish

Plain dyed tea rose

Defect

Ribbed, streaky appearance in the filling

Analysis

Analysis of the cotton filling yarn showed it to be very uniform in size. The cut rubber with which it was covered, however, showed extreme variations in cross-sectional area and weight. These variations produced a thick- and thin-appearing finished yarn, which in turn resulted in the filling streaks.

This condition is less likely to occur in elastic yarns made with extruded-rubber cores, since the latter generally run comparatively uniform in diameter.

CASE 1-23. BROKEN SELVAGES

Fabric

Spun-rayon and cotton dress goods

Construction

Count: 100×44

Warp: 1 end 30/1 1½-in. 1½-den. bright viscose rayon

1 end 30/1 carded cotton

Filling: 15/1 1½-in. 1½-den. bright viscose rayon

Finish

Plain dyed blue

Defect

Selvages broken in wet processing by finisher

Analysis

The finisher complained of a "tight" selvage condition which, he stated, made it impossible to process these goods without frequent breakouts and torn edges. Physical tests on yarns from the selvages and body of the fabric (warp ends) showed no abnormally tight edge. Construction analysis, however, disclosed the fact that the selvages were much heavier and thicker than the body of the goods, most of the pieces examined having as many as four two-ply ends weaving as one. Furthermore, the selvage yarns were made of all spun-viscose rayon. It was agreed that the finisher was not at fault in this case, since such heavy edges are extremely difficult to process without breaking, especially when the wet goods must pass through nip rolls, which exert considerable pressure. In this fabric, too, the edges, being 100% rayon, lost about one-half of their strength when wet and thus became more susceptible to damage than if they had been made of cotton.

CASE 1-24. GREENISH STAINS

Fabric

Spun-rayon linen-type fabric

Construction

Count: 40×40

Warp: 16/1 65% 2-in. $1\frac{1}{2}$ -den. bright viscose rayon
35% $\frac{3}{4}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: Same as warp

Finish

Plain dyed maize

Defect

Greenish stains in both gray and finished goods and tender spots or holes in the finished goods only.

Analysis

Analysis showed the stains to be confined to the warp yarns only. By chemical tests it was found that traces of copper were present in the stains, which could not be removed through any normal scouring operation. Laboratory bleaching of cuttings of the boiled-off goods resulted in the production of holes in the stained areas.

This defect was due to the contamination of the warp yarn during slashing by verdigris or copper-resist stains, the latter being formed by the reaction between copper from metal in the size tank and the free fatty acid in the warp-sizing mix. The tendering in finishing was the result of the catalytic action of the copper in producing localized overbleaching.

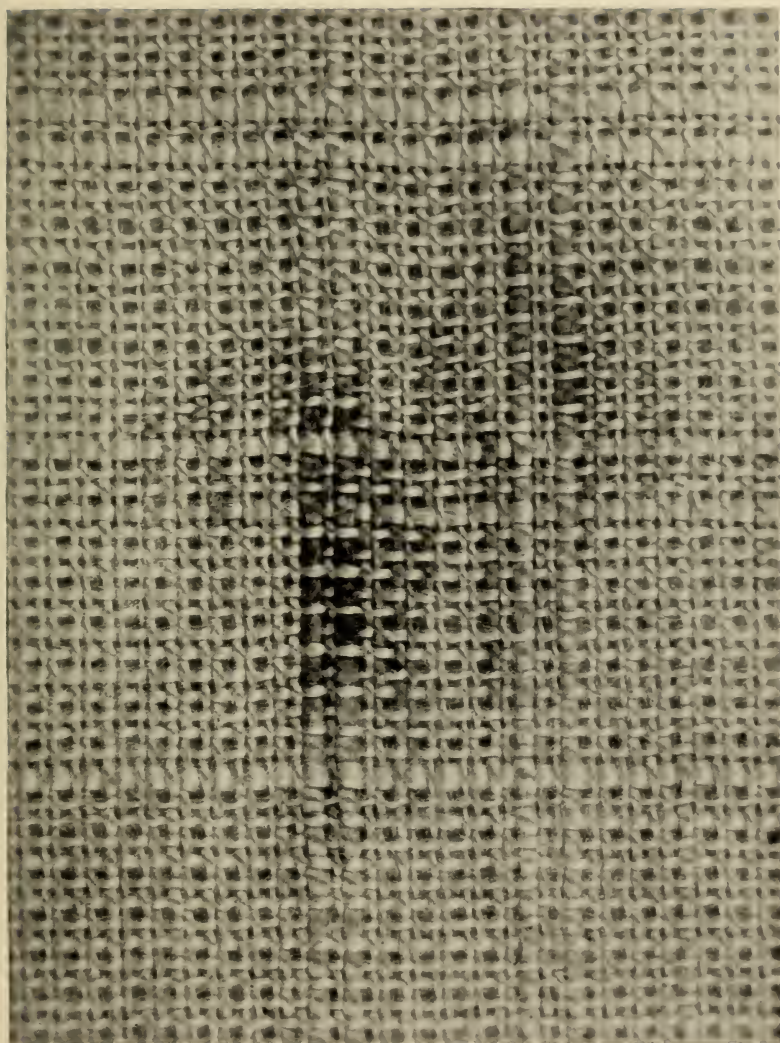


FIG. 16. Deposit on warp yarns.

CASE 1-25. WAVY FACE

Fabric

Alpaca-type dress goods

Construction

Count: 64×60

Warp: 30/1 cotton

Filling: 150/40 bright viscose rayon

Finish

Brown-dyed ground print

Defect

Wavy-face appearance

Analysis

This condition was prevalent in gray goods and in boiled-off and bleached goods, as well as in the finished printed sample submitted. Examination proved it to be due to the presence of very unevenly spun warp yarns, the very thin ends sizing as fine as 38/1 and the very coarse ends as heavy as 27/1. On the gray goods' being wetted out, an almost crepelike effect was produced, resulting in the so-called "wavy" face.

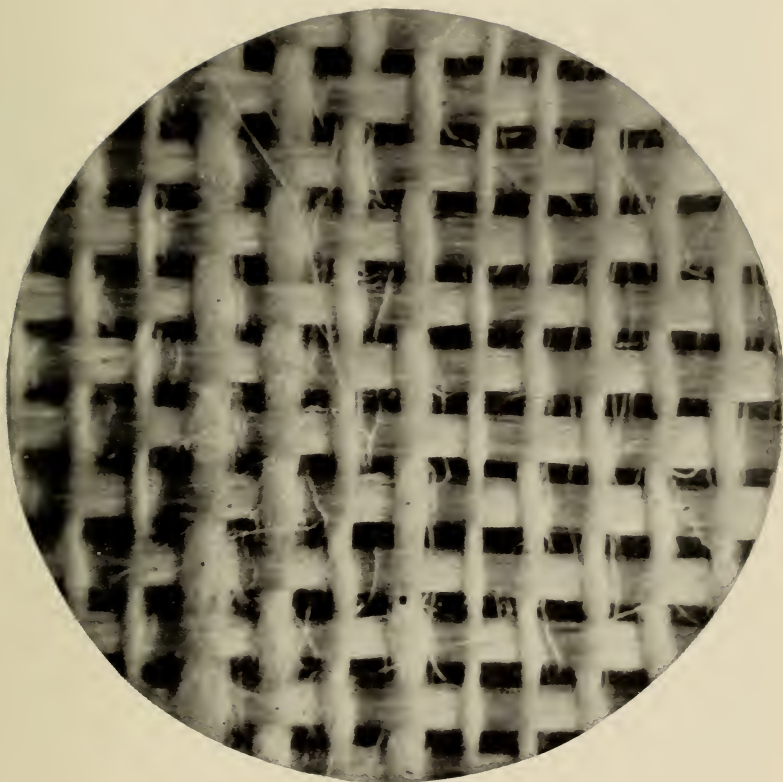


FIG. 17. Uneven warp yarns causing wavy face.

CASE 1-26. PINHOLES

Fabric

Taffeta dress goods

Construction

Count: 200×64

Warp: 75/20 bright acetate rayon

Filling: 120/40 bright acetate rayon

Finish

Plain dyed black

Defect

Customer submitted several finished umbrella tops containing what he described as "pinholes."

Analysis

The so-called "pinholes" were found to be slightly open spaces caused by kinky filling. This is a weaving fault, sometimes caused by filling yarn's sloughing off the bobbin during weaving and generally attributed to too little tension in winding or to too low a relative humidity. In this particular case, it is interesting to note that the kinks were so inconspicuous and appeared so infrequently that they would not have been objectionable to the extent of degrading the fabric if it had been used as dress goods. The unexpected application for umbrella tops made an otherwise unimportant condition a comparatively serious imperfection.



FIG. 18. "Pinholes" due to kinky filling.

CASE 1-27. UNEVEN APPEARANCE

Fabric

Spun-rayon broadcloth

Construction

Count: 110×90

Warp: $50/1$ $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: Same as warp

Finish

Plain dyed beige

Defect

Rough, uneven appearance, commonly described as "teary"

Analysis

The filling ridges were found to be due to slack warp threads or to too heavy sizing on the warp yarns, preventing proper flexibility and uniform interlacing with the filling yarns. It is impossible to eliminate this defect in finishing and the cause is generally attributed to faulty warp tension during weaving or to improper warp sizing, which leaves the yarns fairly rigid. This type of defect is frequently encountered in plain, taffeta-weave, continuous-filament rayon fabrics, in which case the condition produces a "frosty" appearance.

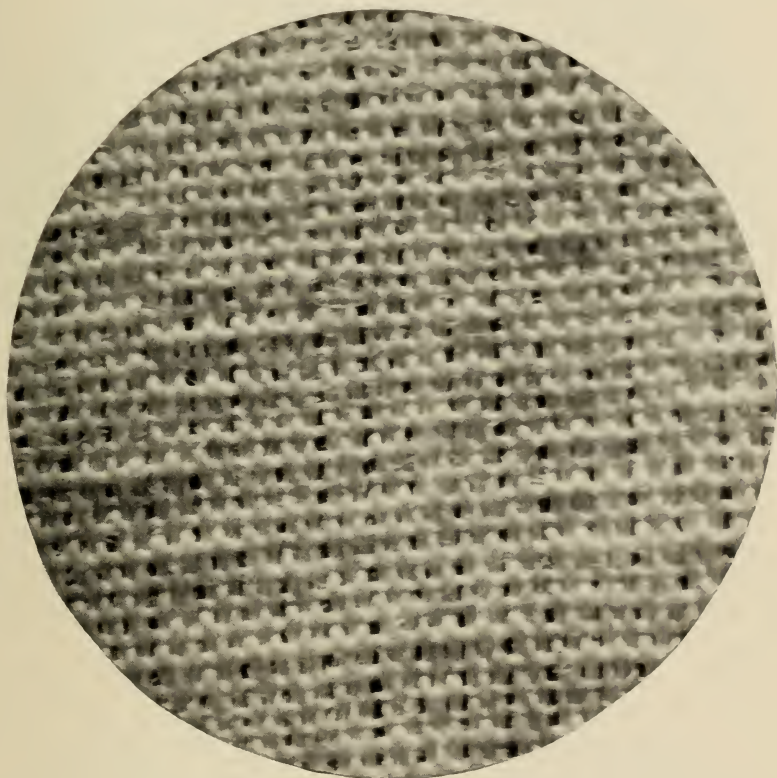


FIG. 19. Rough face due to "tear drops."

CASE 1-28. FILLING STREAKS

Fabric

Ninon curtain fabric

Construction

Count: 80×80

Warp: 75/20/15 bright acetate rayon

Filling: Same as warp

Finish

Plain dyed ecru

Defect

Short filling streaks, giving an open, or "cracky," appearance

Analysis

In the "cracky," or open, places it was found that the twist in the filling yarn averaged about 27 turns per inch, whereas in the normal portions the twist was only 15 turns per inch, as specified. The more highly twisted yarns, being thinner in diameter, produced the streaky effect.

While routine tests are commonly made by mills or throwsters, it is obvious that only a small percentage of the yarns so processed are spot-checked. It is not unusual, therefore, for some slack or high-twist yarns to escape detection until the goods are woven. In this construction, however, the defect should have been just as easy to see during the gray-goods inspection.

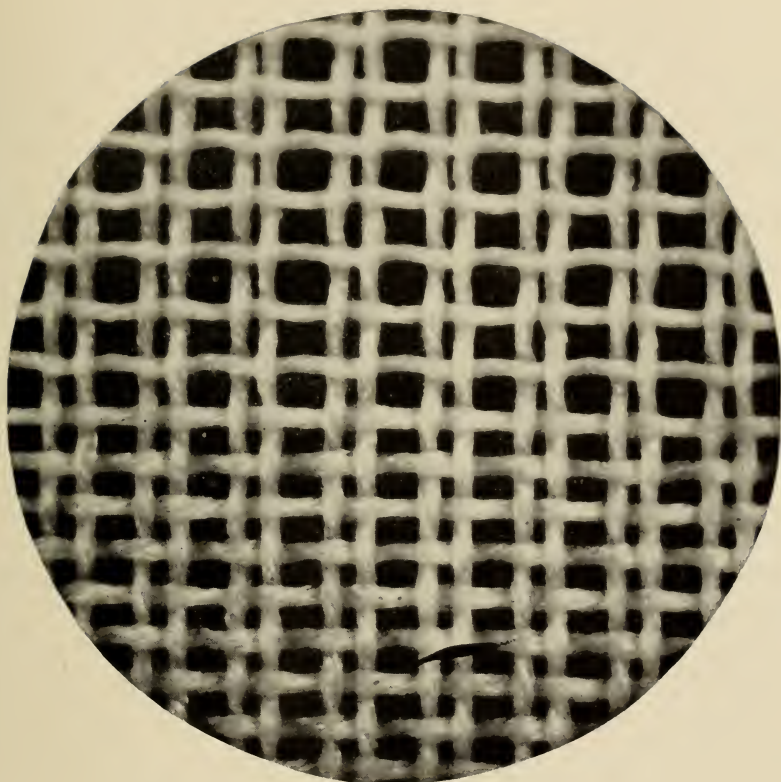


FIG. 20a. Cracky appearance in upper portion.

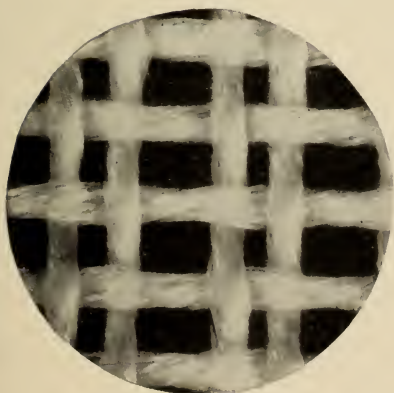


FIG. 20b. Normal twist.

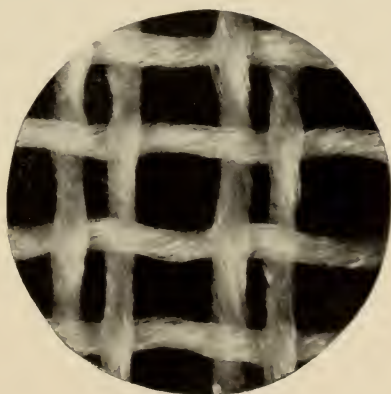


FIG. 20c. High twist.

CASE 1-29. WARP STREAKS

Fabric

Spun-rayon dress goods

Construction

Count: 38×38

Warp: 10/1 70% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. dull viscose rayon
30% $1\frac{1}{2}$ -in. 3-den. dull acetate rayon

Filling: Same as warp

Finish

Cross-dyed black (acetate) and white (viscose)

Defect

Several single warp ends much lighter in color than the balance of the fabric

Analysis

Chemical as well as microscopic analysis showed that the light-appearing ends had only approximately 12% acetate fiber content instead of 30%, as specified, the preponderance of undyed viscose in those ends giving the white-streak effect.

Similar variations in blends are the frequent cause of shade bands or bars when such unevenly blended yarns are used in the filling. There is no fixed tolerance in blends to assure avoidance of streaks and bands in cross-dyed fabrics. The fineness of the filaments, composition, yarn size and twist, and fabric construction all have an effect on what variations may be passable.

CASE 1-30. DIFFERENCE IN HAND

Fabric

Gabardine sportswear

Construction

Count: 92×48

Warp: $30/2$ $1\frac{1}{2}$ -in. 3-den. dull viscose rayon

Filling: $30/2$ combed cotton

Finish

Plain dyed tan

Defect

In a single dye lot of goods several finished pieces were found to have a marked difference in hand, being somewhat stiffer and not so "full" as the others. The dyer also complained that he noticed an even more pronounced difference when the pieces were being dyed.

Analysis

The warp yarns in the firmer samples were found to contain all $1\frac{1}{2}$ -denier viscose-rayon staple, whereas the warp yarns in the others were composed of all 3-denier viscose-rayon staple, as specified. The goods containing the finer denier were more compact and somewhat stiffer, particularly when they were wet, because of the greater volume of swelling of the finer filaments. The gray mill was responsible for having mixed two styles in the same shipment, the only difference being that of the warp yarn composition.

CASE 1-31. FILLING "SHINERS"

Fabric

Oxford dress goods

Construction

Count: 60×42

Warp: 30/1 cotton

Filling: 300/40 bright viscose rayon

Finish

Plain dyed tan

Defect

Short lengths of bright, or "shiny," filling yarns

Analysis

Single-strand breaking-strength and elongation tests made on the short bright sections of filling yarn showed them to have only about 18.5% residual elongation, as compared with an average of 22.5% elongation in the normal portions. On the removal of the bright-appearing yarns from the fabric, it was found that they had much less crimp than the normal yarns. Physical tests made on some of the original yarn before weaving showed it to have a normal elongation of about 24% at the breaking load. This defect was due to overstretched filling yarn, the taut section with less crimp resulting in greater light reflection and a shiny appearance. With no proof of the yarn's having been delivered to the mill in a stretched condition, it was assumed that the damage was caused by the use of excessive tension in quilling.



FIG. 21. Tight filling yarn.

CASE 1-32. CUT FILLING

Fabric

Alpaca-type dress goods

Construction

Count: 64×60

Warp: 60/1 combed cotton

Filling: 150/40 bright viscose rayon

Finish

Plain dyed pink

Defect

Small holes throughout piece

Analysis

Microscopic examination showed that the holes were due to cut filling yarns. In some instances the same yarn was severed in two consecutive places across the filling. Obviously, the yarn could not have been cut in this peculiar manner at the time of weaving. This defect was traced to a condition known as "sand-roll cuts," fairly common in the early days of rayon weaving when take-up rolls covered with perforated tin, sandpaper, or card clothing were used on looms, the sharp edges cutting the delicate rayon filaments readily during weaving. In modern rayon-weaving looms, the take-up rolls are of large diameter, to minimize slippage of the cloth by providing greater surface of contact; and they are covered with crepe rubber or composition material, which grips the fabrics with no danger of cutting.

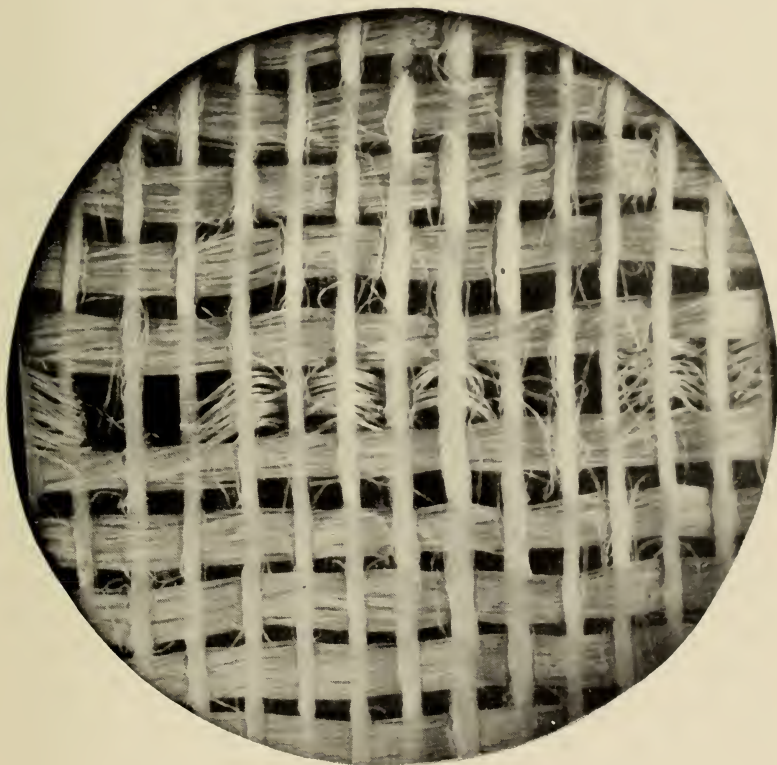


FIG. 22. Yarn cut by sand roll.

CASE 1-33. WARP STREAK

Fabric

Combination-yarn alpaca-type dress goods

Construction

Count: 52×40

Warp: 150/60 dull acetate plied 14 turns with 100/40 viscose crepe

Filling: Same as warp

Finish

Plain dyed rose

Defect

Single light warp streak

Analysis

Analysis showed that the streak, which appeared to be lighter in shade than normal, was due to an end of 40-filament acetate yarn which had been accidentally introduced in one of the combination yarns instead of 60-filament yarn used in the remainder of the warp. The coarser filament yarn in this case happened to be of a different make of yarn and normally dyed lighter than the 60-filament acetate yarn. It should be noted that, while coarser filament yarns usually dye *darker* than the finer filament yarns of the same manufacturer, the dyeing differences may be the reverse when comparison is made between yarns of different origin.

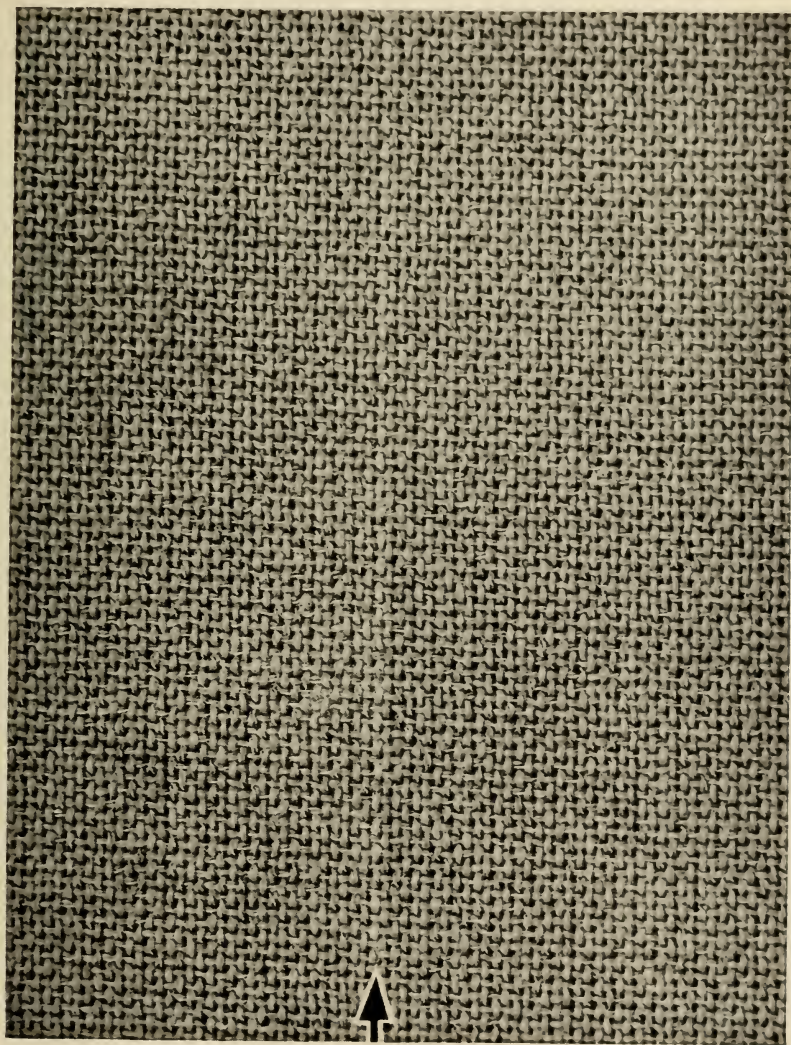


FIG. 23. Streak due to wrong acetate-rayon end.

CASE 1-34. TWO-TONE EFFECT

Fabric

Spun-rayon dress goods

Construction

Count: 96×92

Warp: 17/1 75% 2-in. 3-den. dull viscose rayon

25% 2-in. 4-den. bright Bemberg rayon

Filling: Same as warp

Finish

Plain dyed rose

Defect

Mottled or "two-tone" effect, which the dyer claimed he was unable to eliminate

Analysis

It will be noted from the fabric construction (which was confirmed by laboratory analysis of the sample submitted) that it was made of a blend of dull viscose and bright Bemberg rayon staple. Since all cuprammonium rayon dyes appreciably darker than most viscose-process yarns in the same bath, the two-tone effect is unavoidable. In this case it was decided that the blend was not a suitable one. It might have been possible, by selecting a viscose rayon which was exceptionally dark-dyeing, to obtain a combination that would show a minimum of the cross-dye effect. Also, the use of a bright-luster viscose staple would probably be of some help in minimizing the contrast, since dull fiber of the same make and denier always appears lighter in shade, though dyed in the same bath.

CASE 1-35. RED STREAKS

Fabric

Underwear French crepe

Construction

Count: 150×94

Warp: 75/50 bright acetate rayon

Filling: 75/30/35 semidull viscose rayon

Finish

Plain dyed white

Defect

Small bright-red streaks running fillingwise throughout piece

Analysis

On casual examination it appeared that the short red streaks were due to unremoved fugitive tint on the filling yarn or to staining by the dyer. Microscopic analysis, however, revealed the presence of a number of short, single, red-cotton fibers woven into the filling. In other places the streaks were apparently mark-offs from these red fibers produced during wet processing. It was possible to eliminate the defect by stripping with sodium hydrosulphite solution. This would not be done in normal processing by the finisher and, under the circumstances, it would necessitate extra handling and a small additional charge for this treatment.

It was subsequently determined that several pieces of these goods had been woven on looms with red-cotton plush facing on the race plates. The contamination was due to some of the red-cotton fibers' coming out and being trapped in the fabric during weaving. In cases in which the goods were finished in medium and dark shades, the contaminating fibers were not visible.

CASE 1-36. WARP STREAKS

Fabric

Piqué "sharkskin" sportswear

Construction

Count: 100×60

Warp: 300/80 dull acetate rayon

Filling: Same as warp

Finish

Plain dyed gray

Defect

Several narrow dark warp streaks running throughout the full length of the piece

Analysis

Microscopic examination showed that this condition was due to uneven spacing of the warp yarns resulting in uneven penetration of the dyestuff. This finding was confirmed by unraveling a number of warp threads and revealing the presence of warp-wise streaks on the remaining filling threads caused by greater dyestuff penetration in those areas. The uneven distribution of the warp yarns may have been due to a damaged loom reed, or to so-called "weak" dents in the reed, or to some other mechanical displacement of the normal, even spacing of the yarns.

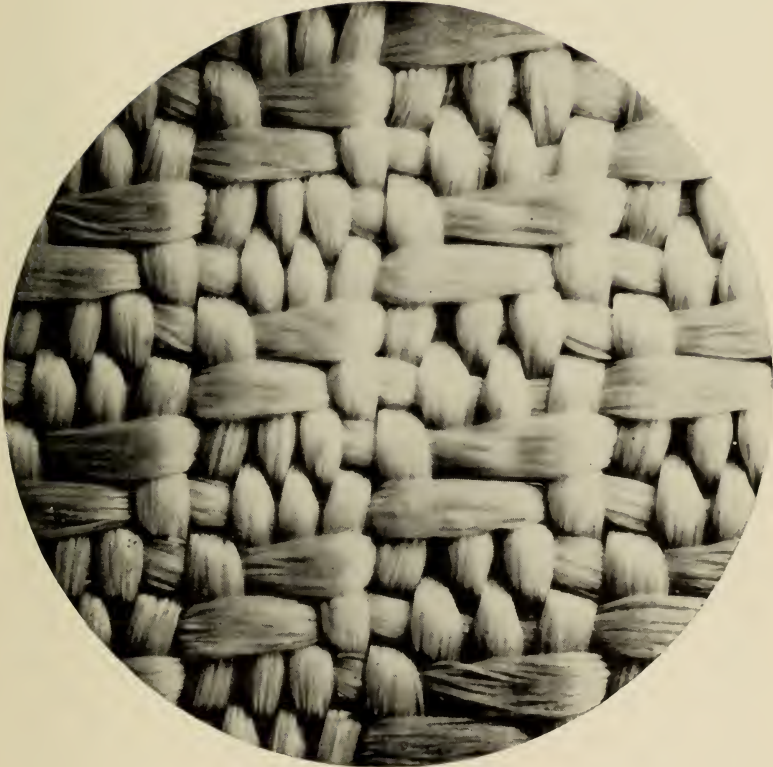


FIG. 24. Uneven spacing of warp yarns.

CASE 1-37. FILLING STREAKS

Fabric

Novelty dress goods

Construction

Count: 88×80

Warp: Eight ends 75/30/35 bright viscose rayon, 2 S and 2 Z, alternating with two ends 120/40 dull acetate rayon

Filling: Eight picks 100/40 dull viscose rayon alternating with two picks 120/40 dull acetate rayon to make checked pattern

Finish

Cross-dyed green (viscose) and white (acetate)

Defect

White filling stripes wider than normal

Analysis

The fabric was made on a multiple-box loom in which eight picks were normally woven with the green-dyed yarn and two picks with the white-dyed yarn. In this case there were four adjacent picks of the white yarn, producing a white filling stripe that was twice the width of the normal stripe. This condition was produced by a faulty box motion on one loom, the mechanism which raised or lowered the set of shuttle boxes not functioning in the proper rotation to give the desired pattern.

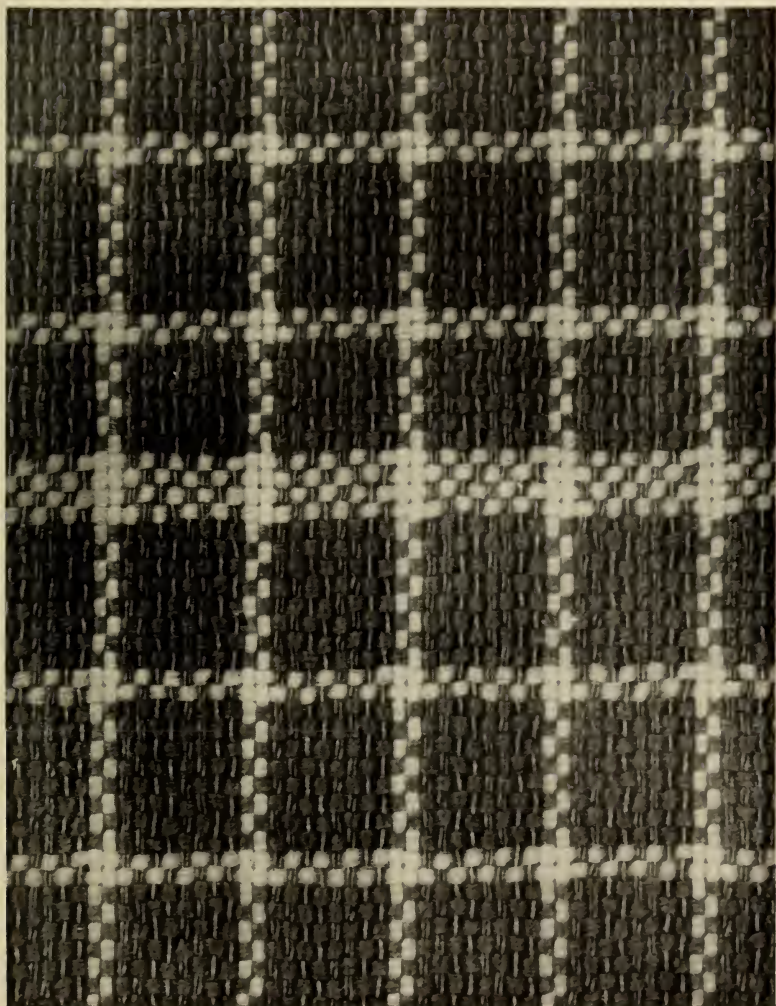


FIG. 25. Additional white picks inserted by faulty box motion.

CASE 1-38. WARP STREAKS

Fabric

Combination-yarn dress goods

Construction

Count: 55×50

Warp: 100/40 dull acetate rayon, plied S with 75/30 viscose-rayon crepe

Filling: Same as warp

Finish

Plain dyed navy

Defect

Short warp streaks

Analysis

The dyestuff on a small cutting of the finished goods was stripped and the viscose component only then redyed, producing a cross-dyed effect. It was noticed that the warp streaks, coinciding with the original, were very much accentuated. This was evidence of a lack of uniformity in the proportion of viscose-crepe and acetate yarns in the plied combination. Analysis of the twist confirmed this finding, in some cases there being as much as 50% difference in the contraction of the creped-yarn component, as compared with the normal nonstreaky combination ends. This defect is accentuated when the dyestuff penetration is poor or the color match between the acetate and the viscose is not perfect. In this particular case, however, the color match was found to be reasonably good and commercially acceptable.

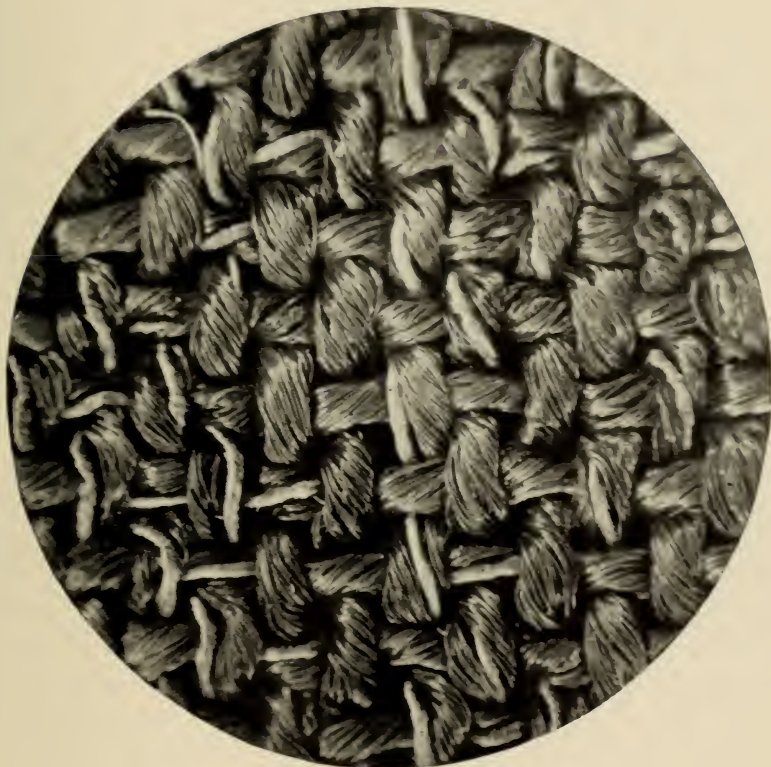


FIG. 26. Uneven ply-twist contraction.

CASE 1-39. WARP STREAKS

Fabric

Sheer dress goods

Construction

Count: 108×100

Warp: 100/40 S and Z viscose-rayon crepe

Filling: 45-den. real-silk crepe, 2 S and 2 Z

Finish

Plain dyed light blue

Defect

Short, bright, single warp streaks

Analysis

Microscopic examination showed that the bright, single warp streaks were due to sections of warp yarns with much less twist than the remainder of the yarns. Twist determinations were made and the slack portions were found to have only about 30 turns per inch, instead of the normal specified 55 turns. The defective portions were found to be present in both S- and Z-twist yarns. When the sample was examined microscopically, a number of continuous warp streaks were detected, resulting from wrong draws, but this defect was not so noticeable as the faulty twist and apparently was not reported by the cutter.

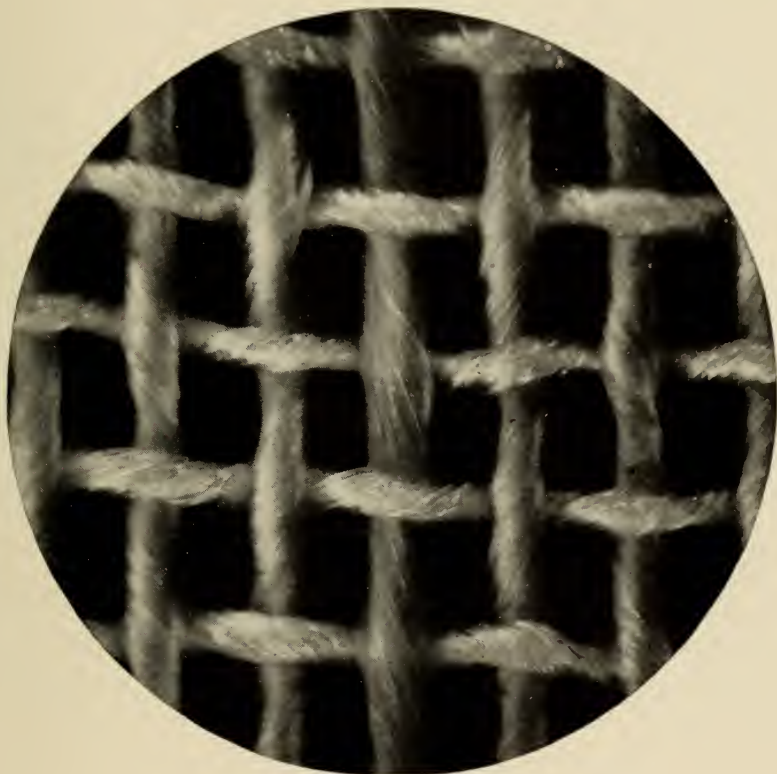


FIG. 27. Low twist in single warp yarn.

CASE 1-40. FILLING BANDS

Fabric

Novelty crepe dress goods

Construction

Count: 56×52

Warp: 75/30 viscose-rayon crepe ply-twisted 30 turns with
75/20 acetate rayon, woven 2 S and 2 Z

Filling: Same as warp

Finish

Plain dyed medium blue

Defect

Several bands of filling which were darker in shade than the remainder of the fabric

Analysis

Analysis showed that, in the faulty-appearing sections, the ply twist in one shuttle (Z twist) was only about 23 turns, instead of the normal 30 turns, per inch. As a result, there was more dyestuff penetration in that yarn, producing darker filling bands.

CASE 1-41. WARP STREAK

Fabric

Sharkskin-type dress goods

Construction

Count: 112×50

Warp: 150/40 dull acetate rayon

Filling: 300/80 dull acetate rayon

Finish

Plain dyed tan

Defect

Single dark warp streak about $\frac{1}{4}$ inch wide and about $3\frac{1}{2}$ inches from one selvage

Analysis

Microscopic examination of the sample showed a bruising of the yarns in the narrow warp streak resulting in the yarn's dyeing darker in that section. This defect, showing damage to both warp and filling yarns on one face of the cloth only, was attributed to a chafe on the loom by a rough temple roll or by excessive pressure of the roll.

Fabrics of this type are particularly sensitive to bruising or even slight distortion of the yarns. Very often too great pressure of the temple roll will leave a mark without actually damaging the yarns. Dyestuff penetration in acetate-rayon sharkskin constructions is not too good at best, and any separation of the yarn filaments or the rupture of a few of them permits greater absorption of the color.

CASE 1-42. FILLING TRAMMAGE

Fabric

Novelty spun-rayon crepe dress goods

Construction

Count: 60×44

Warp: 75/30 viscose rayon crepe, plied S twist with 30/1
2-in. 3-den. bright viscose rayon

Filling: Same as warp, but woven with two picks of S twist
and two picks of Z twist

Finish

Plain dyed light blue

Defect

Occasional bands of fillingwise "trammage"

Analysis

In the narrow puckered areas, the filling crepe yarn was found to have all S twist instead of alternating with two picks of Z twist, as specified. This concentration of unbalanced one-way twist resulted in a higher filling shrinkage, producing the puckered, or *plissé*, effect, generally called "trammage."

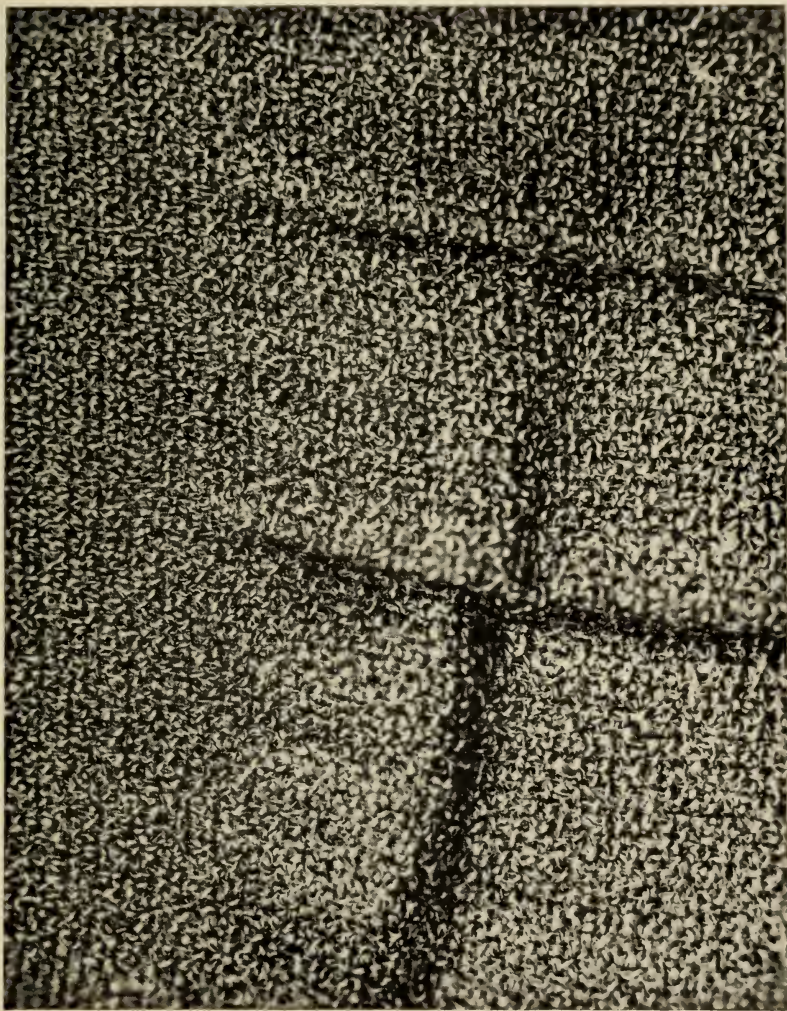


FIG. 28. Warpwise creases due to band of filling with all one-way twist.

CASE 1-43. NARROW FILLING BANDS

Fabric

Novelty taffeta dress goods

Construction

Count: 90×68

Warp: 100/60 dull viscose rayon

100/26 black-dyed acetate rayon

100/40 dull acetate rayon

Filling: 150/90 dull viscose rayon

Finish

Cross-dyed blue (viscose) and white (acetate)

Defect

Narrow filling bands at regular intervals of about every 25 inches throughout the piece

Analysis

Actual measurements showed a decided difference between the crimp of the warp yarns in the dark-banded sections as compared with those in the light sections. For example, where there appeared to be a dark band, the contraction of the black-dyed yarn was found to be approximately eight times as great as it was in the light sections. This additional black-dyed yarn covered more of the adjacent lighter dyed yarns and produced the illusion of filling bands. This fabric was woven with multiple warp beams, and the defect was apparently caused by a periodic variation in the loom let-off of one beam during weaving, resulting in more contraction in the black-dyed yarn.

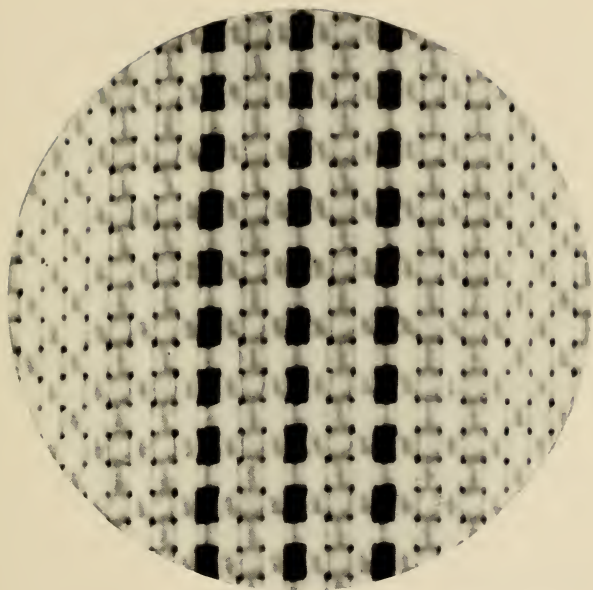


FIG. 29a. Normal warp contraction in black yarns.

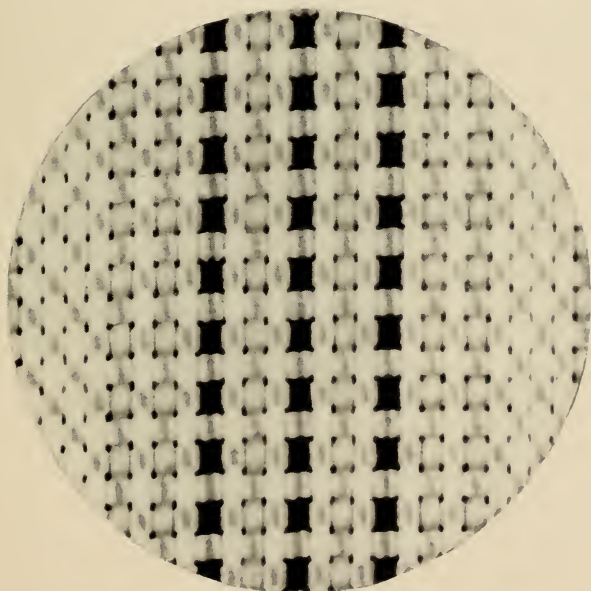


FIG. 29b. Excessive warp contraction in black yarns.

CASE 1-44. WARP STREAKS

Fabric

Gabardine sport shirting

Construction

Count: 128×60

Warp: 30/1 80% 1½-in. 1½-den. bright viscose rayon
20% 1½-in. 3-den. bright viscose rayon

Filling: Same as warp

Finish

Plain dyed light gray

Defect

Short bright streaks in warp

Analysis

Microscopic analysis showed that the streaks coincided with short low-twist places in the warp yarn. Twist determinations made on 1-inch lengths of the warp yarn showed the normal sections to have an average of 19.8 turns per inch, whereas the bright streaks had an average of only 10.6 turns per inch. The lower twist yarns reflected more light and also were much thicker in diameter than the normal ends.

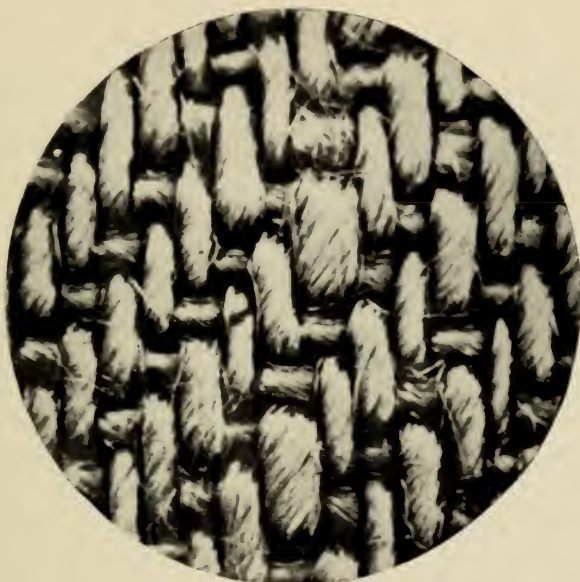


FIG. 30a. Uneven yarns in fabric.

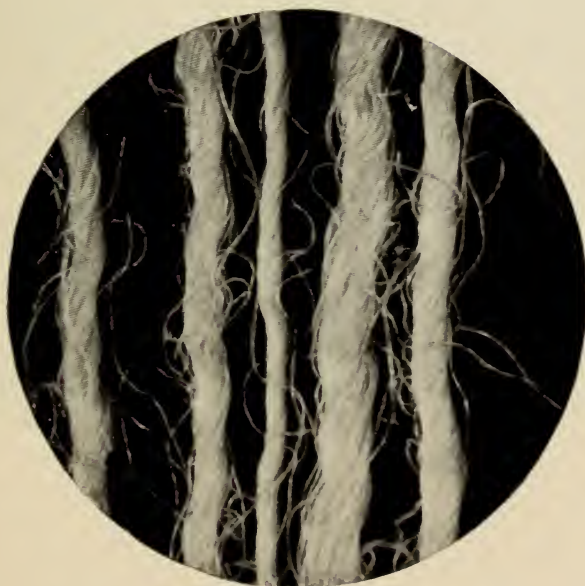


FIG. 30b. Uneven yarns removed from fabric.

CASE 1-45. FILLING BANDS

Fabric

Spun-rayon sheer dress goods

Construction

Count: 50×48

Warp: 18/1 70% 1½-in. 1½-den. bright viscose rayon
30% 1½-in. 3-den. dull acetate rayon

Filling: Same as warp

Finish

Plain dyed blue

Defect

Light-dyed filling bands

Analysis

The light filling bands in the sample submitted were found to contain yarn composed of one roving of spun viscose and acetate and one roving of all-bright spun rayon and wool. Since the wool remained undyed, the resultant bands of this yarn were lighter in shade than the normal blend. This defect was produced by the mixing of rovings in the mill during spinning.

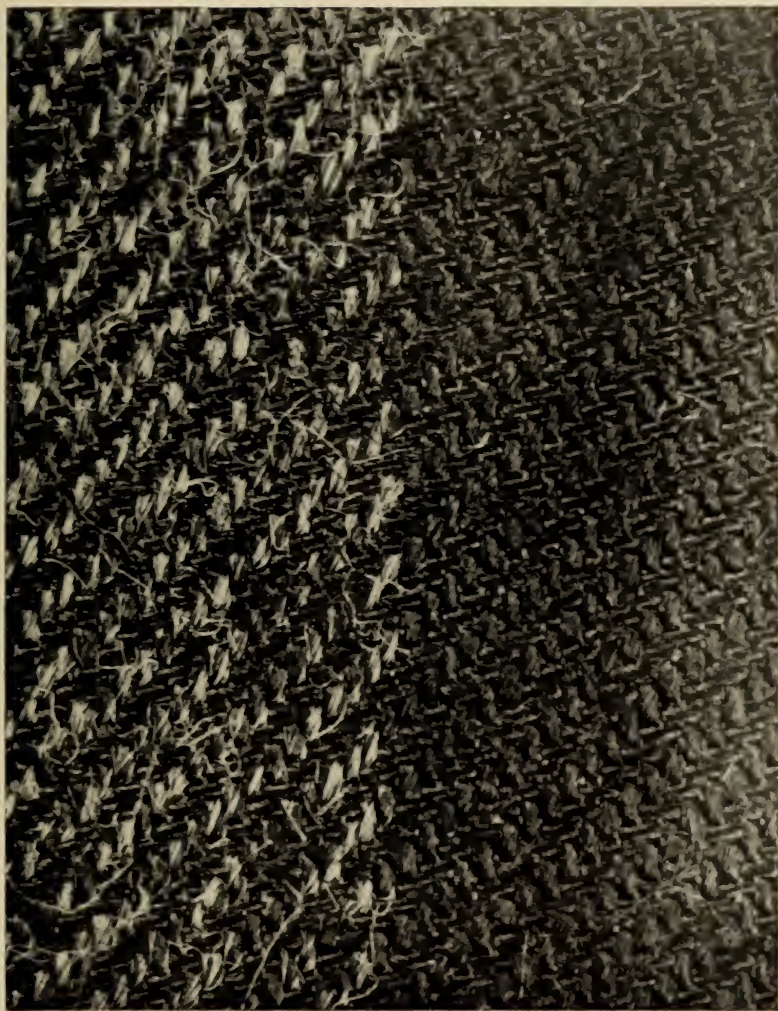


FIG. 31. Band due to mixed roving containing undyed wool.

CASE 1-46. DARK SLUBS

Fabric

Spun-rayon-blend flannel dress goods

Construction

Count: 58×50

Warp: 15/1 50% 2-in. 1½-den. dull viscose rayon
50% 2-in. 3-den. dull acetate rayon

Filling: Same as warp

Finish

Cross-dyed dark green (viscose) and white (acetate)

Defect

Long dark slubs throughout warp and filling

Analysis

Microscopic analysis showed the dark slubs to be composed almost entirely of the viscose rayon (dyed green). This defect was apparently caused by faulty blending and drawing.

If these goods had been dyed in solid shades and a good color match obtained between the viscose and acetate, this particular defect would have been much less noticeable.

CASE 1-47. DARK STREAKS NEAR SELVAGE

Fabric

Iridescent-type cotton-and-nylon dress goods

Construction

Count: 96 \times 86

Warp: 70/34 semidull nylon

Filling: 60/1 combed cotton

Finish

Plain dyed helio

Defect

Dark-appearing sections running warpwise about 4 inches in width adjacent to each selvage

Analysis

Microscopic examination showed no evidence of any mechanical damage to either the warp or the filling yarns in the dark-appearing sections. Laboratory stripping and redyeing resulted in considerable improvement, but not in complete removal of the dark sections. This defect was at first attributed to a slight distortion or imperceptible damage by the temple rolls. However, it was later learned that the weaving mill had used small pads saturated with a sulphonated oil and placed in contact with the warp yarns on the loom on either side, adjacent to the selvages, to provide for better weaving. With this information as a guide, chemical extraction of the warp yarns in the finished goods showed small amounts of unremoved oil in the dark areas. It appeared that normal scouring operations by the dyer did not completely remove this oil, which had been assumed to be readily emulsifiable, but which probably was too much absorbed by the nylon or affected by aging when the gray goods were not processed immediately.

CASE 1-48. WARP STREAK

Fabric

Satin dress goods

Construction

Count: 212×68

Warp: 100/40 bright acetate rayon

Filling: Same as warp

Finish

Plain dyed black

Defect

Single intermittent warp streak throughout piece

Analysis

The "dotted-line" effect in the warp was found to be due to a harness skip, resulting in one of the acetate warp ends' floating over several picks at intervals, thus becoming more pronounced on the surface.

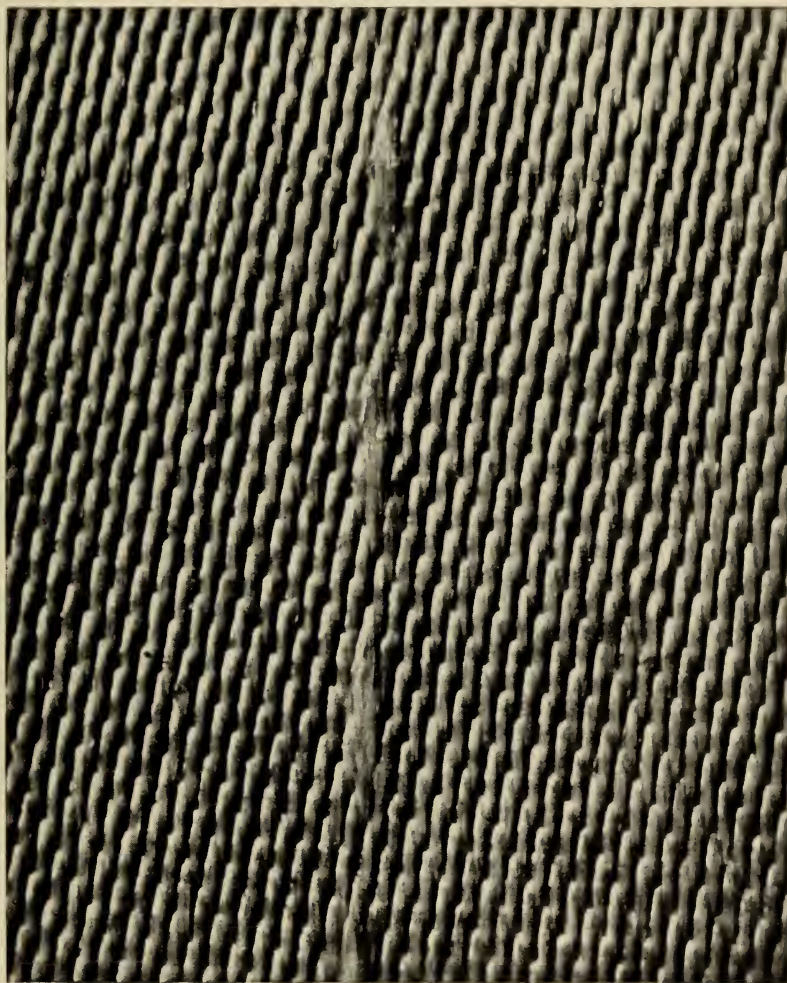


FIG. 32. Floating end due to harness skip.

CASE 1-49. WARP STREAKS

Fabric

Spun-rayon dress goods

Construction

Count: 118×58

Warp: 18/1 80% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. dull viscose rayon
20% 58's wool cut $1\frac{1}{2}$ in.

Filling: Same as warp

Finish

Plain dyed navy

Defect

Short white warp streaks

Analysis

Microscopic and chemical analysis showed that the white streaks were due to the presence of undyed fibers of 3-denier dull cellulose acetate rayon staple twisted in with the normal viscose and wool-blended warp yarn. In this particular case, it was possible to salvage all of the gray goods suspected of containing the contaminating cellulose acetate rayon fibers by segregating the pieces and having them dyed for acetate as well as for the viscose and wool in the same bath at no added cost.

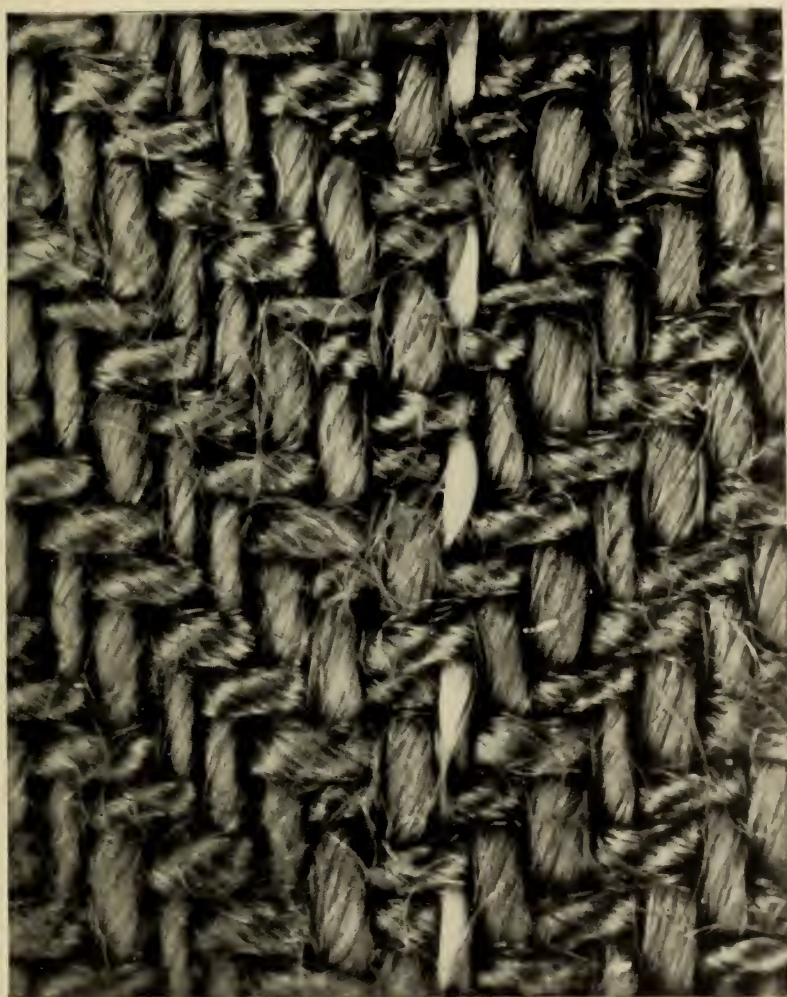


FIG. 33. Streak due to undyed acetate-rayon fibers in warp.

CASE 1-50. LACK OF PUCKER

Fabric

Rayon-and-cotton seersucker dress goods

Construction

Count: 88×72

Warp: 150/40 dull acetate-rayon ground

36/2 combed-cotton puckered stripe

Filling: 150/40 dull acetate rayon

Finish

Cross-dyed green (cotton) and white (acetate)

Defect

Pieces with much less warp pucker than normal

Analysis

In a woven seersucker construction, the pucker is obtained by taking the warp yarn from two beams. One is held under ordinary tension for the ground weave, while the other is allowed to run slack, to permit the weaving in of those warp yarns at a faster rate, producing the crinkled effect. It was first suspected that the flat-appearing pieces had been excessively stretched in finishing, so that some of the crinkle was pulled out; but analysis of the pick count proved that the warpwise shrinkage in finishing was exactly the same in both the normal and the flat pieces. The lack of pucker was attributed to too much tension on the slack beam during weaving, which resulted in insufficient contraction in the colored stripe. Take-up of this yarn in one of the normal pieces was found to be 29.5%, whereas in one of the flat pieces it was only 17.5%.



FIG. 34a. Normal seersucker.



FIG. 34b. Flat seersucker.

CASE 1-51. WARP STREAKS

Fabric

Spun-rayon blended dress goods

Construction

Count: 88×50

Warp: $34/2$ 50% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon
50% $1\frac{1}{2}$ -in. 3-den. dull acetate rayon, woven with
two double ends alternating with two single
ends

Filling: Same as warp

Finish

Cross-dyed tan (viscose) and beige (acetate)

Defect

Warp streaks

Analysis

Inspection of the full piece showed the warp streaks to be present in a regular pattern across the full width of the fabric, every other pair of double ends being more prominent than the others. This defect was traced to poor reeding, every other pair of doubles being split in the reed.

The reeding of some constructions is extremely critical, and lack of care or skill in this operation can result in poor appearance of the finished goods.

CASE 1-52. STICKY SPOTS

Fabric

Taffeta dress goods

Construction

Count: 104×76

Warp: 75/20 bright acetate rayon

Filling: 100/40 bright acetate rayon

Finish

Plain dyed beige

Defect

Small spots scattered throughout piece

Analysis

Microscopic examination showed that the spots were in the form of amorphous sticky deposits, confined to the warp yarns only, although in many cases the filling had also been contaminated from contact with the warp. It was practically impossible to remove this substance but chemical tests indicated that it was of a rubberlike nature. The defect was traced to similar deposits in the gray goods and, by checking the looms on which the fabric was woven, it was learned that the surface of the crepe-rubber-covered take-up rolls was spongy and sticky. Apparently the damage was caused by some of the sticky rubber's adhering to the warp during weaving. It was later determined that some components of the warp sizing were causing the deterioration of the rubber and it was possible to correct this condition by changing the size formula.

CASE 1-53. WARP STREAK

Fabric

Spun-rayon dress goods

Construction

Count: 65×58

Warp: 30/1 50% 1½-in. 1½-den. bright viscose rayon
50% 1½-in. 1½-den. dull viscose rayon

Finish

White polka-dot print on gold ground

Defect

Single warp streak throughout piece

Analysis

Microscopic examination disclosed that the streak was due to two warp ends weaving as one. This fault was probably the result of faulty drawing-in when the warp was drawn through the harness heddles prior to weaving.

The dyeing of head ends in the gray mill is often of great value in detecting such imperfections as mixed warp ends or wrong draws.

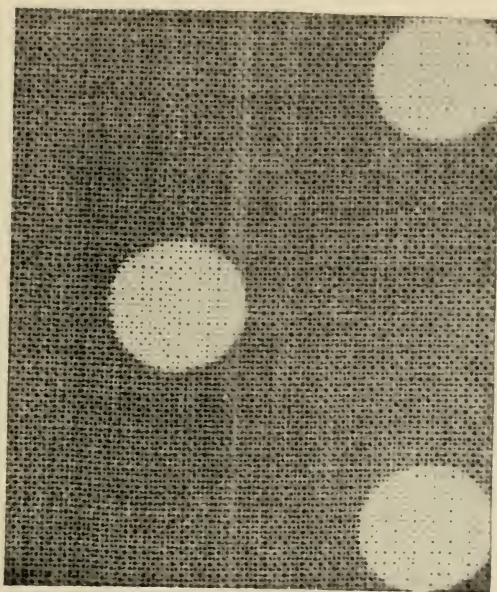


FIG. 35a. Streak due to wrong draw.



FIG. 35b. Enlarged view—two ends weaving as one.

CASE 1-54. DARK STREAKS

Fabric

Rayon-and-wool dress goods

Construction

Count: 84×46

Warp: $24/2$ 60% 2-in. $1\frac{1}{2}$ -den. dull viscose rayon
40% 64's wool cut 2 in.

Filling: $12/1$ same blend as warp

Finish

Plain dyed white

Defect

Short dark streaks in warp and filling

Analysis

Analysis showed that the short dark streaks were due to the presence of numerous dark-brown and black wool hairs spun in with the regular yarns. When wool is used for blends to be finished in white or light shades, it must be especially selected for freedom from black hairs, since there is no means of removing or bleaching them in finishing.



FIG. 36. Black hairs in white finished goods.

CASE 1-55. FILLING BANDS

Fabric

Cotton-filled rayon sateen

Construction

Count: 145×76

Warp: 150/40 bright viscose rayon

Filling: 60/2 combed cotton

Finish

Plain dyed olive drab

Defect

Several dark-dyed filling bands, starting and stopping at shuttle changes

Analysis

Laboratory stripping and redyeing resulted in no improvement, and physical analysis of the light- and dark-dyed filling yarns showed them both to be of the same size and twist. Microscopic analysis and chemical tests, however, revealed the fact that the light-dyed cotton was not mercerized, whereas the dark (normal) yarns were mercerized. This difference in dyeing is characteristic of mercerized and unmercerized cotton, and further study showed that the mill had been purchasing two types of yarns and had mixed them during weaving.

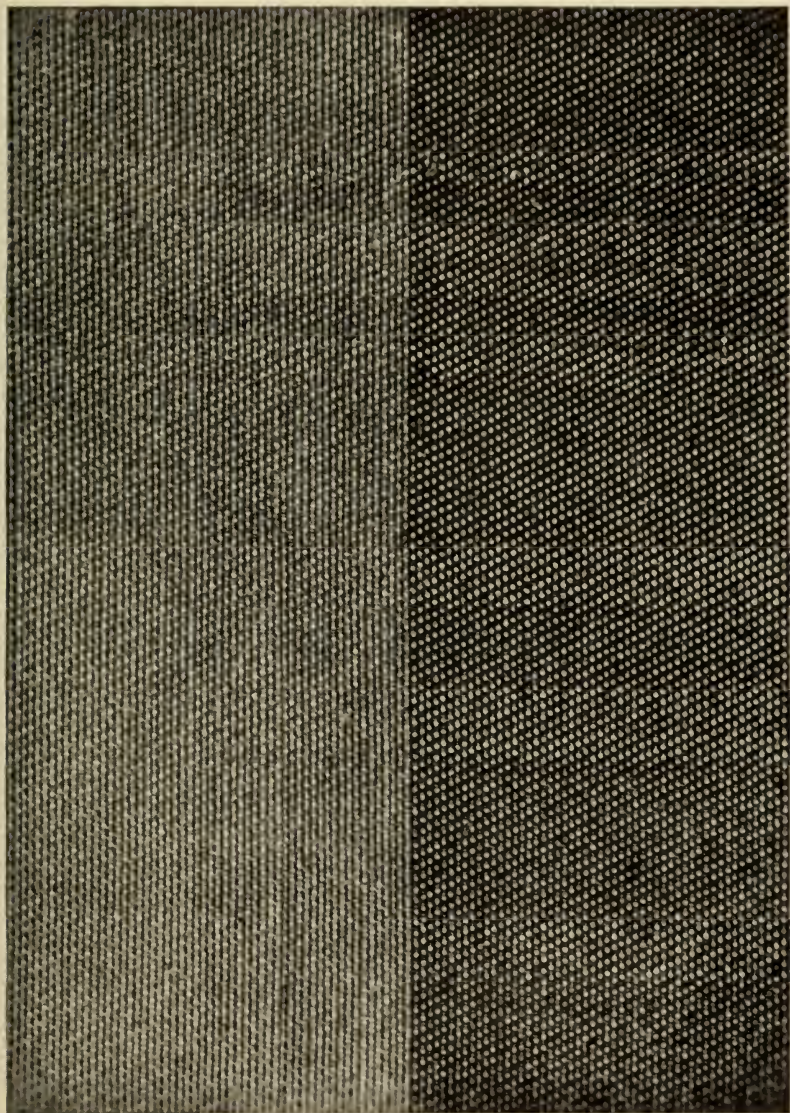


FIG. 37. Mixed filling—mercerized and unmercerized cotton.

CASE 1-56. LIGHT SPECKS

Fabric

Twill suiting

Construction

Count: 90×48

Warp: $30/2$ $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. dull viscose rayon

Filling: $30/2$ combed cotton

Finish

Plain dyed light blue

Defect

Light specks in the filling

Analysis

Microscopic analysis showed that the light specks (undyed) were neps of immature or so-called "dead" cotton fiber. While a certain amount of such fibers are present in all cotton, poorer qualities will contain an excessive proportion of such fiber. In some cases these neps are removed in carding and combing. Also, in the case of all cotton goods which receive very severe boil-off and mercerization, there is further opportunity to minimize the appearance of such cotton-fiber imperfections.

CASE 1-57. WARP AND FILLING SLUBS

Fabric

Challis dress goods

Construction

Count: 68 × 62

Warp: 30/1 1½-in. 1½-den. bright viscose rayon

Filling: Same as warp

Finish

Plain dyed blue

Defect

Short light-colored slubs in both the warp and the filling

Analysis

Microscopic examination of the slubs showed them to be bunches of cotton fly, which were dyed much lighter than the viscose rayon, as is usually the case.

Contamination of rayon stock by cotton fly is not uncommon in mills in which both fibers are processed. From the appearance of this particular defect it is quite probable that preparatory equipment, such as the cards, had not been thoroughly cleaned and made free from the contaminating cotton prior to running through the rayon fiber.

CASE 1-58. SHIFT-STAMP MARK

Fabric

Brassiere satin

Construction

Count: 300×84

Warp: 75/20 bright acetate rayon

Filling: 150/40 dull acetate rayon

Finish

Plain dyed tea rose

Defect

D/N shift stamp not removed in finishing

Analysis

It is common practice in a weave room to use a fugitive ink stamp mark to indicate on a piece of goods during weaving the change in shift of the weaver. In this case, the mill employed a stamp with the letters D/N on the back of the fabric. Laboratory scouring tests on a finished cutting showed that the mark could not be eliminated in normal processing. Similar tests made on a gray cutting confirmed the fact that it was possible to remove the mark only with considerable agitation in a beaker containing a hot soap solution. Since this type of fabric receives a jig boil-off, the agitation and scouring procedure are comparatively mild, and the mill was considered at fault. It was later learned that the ink on one of the stamp pads in the weave room had been badly contaminated and aged through use over a long period of time, and the marking was no longer fugitive, particularly when too heavy an impression was made.

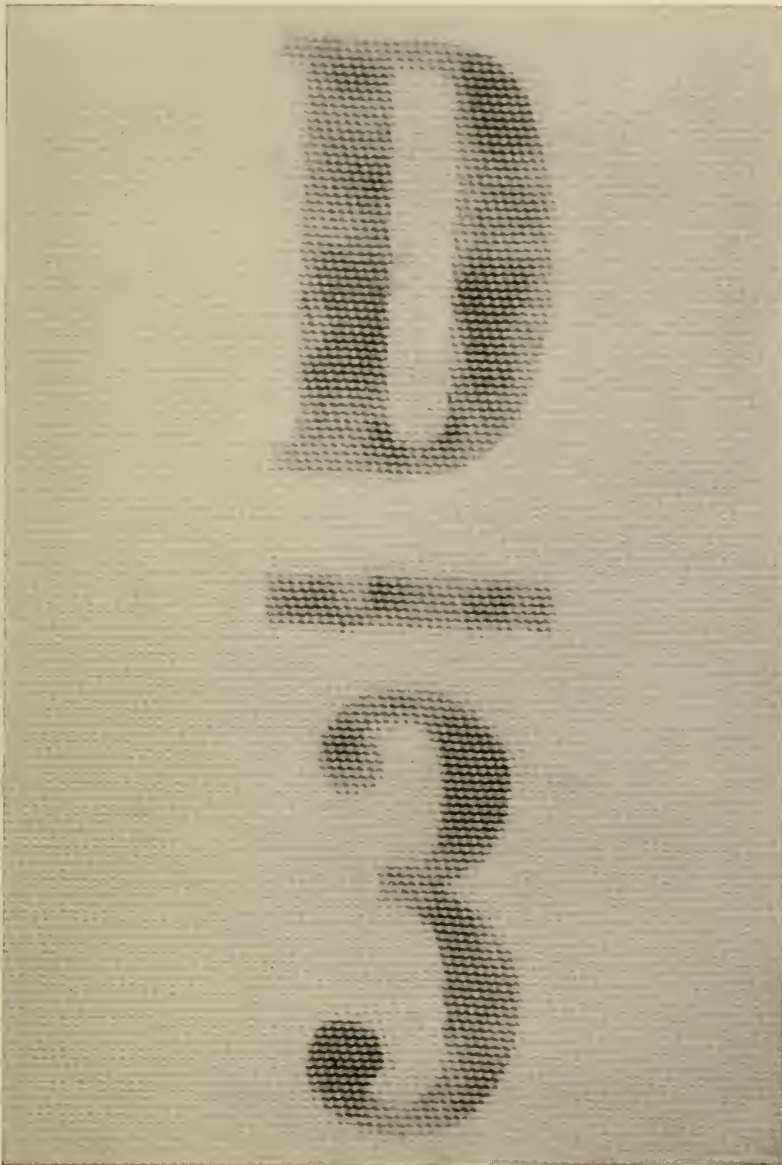


FIG. 38. Nonfugitive stamp mark.

CASE 1-59. BLOTCHY APPEARANCE

Fabric

Spun-rayon and wool-blend suiting

Construction

Count: 90×44

Warp: 30/2 25% 1½-in. 1½-den. bright viscose rayon
50% 2-in. 3-den. dull viscose rayon
25% 58's wool cut 2 in.

Filling: Same as warp

Finish

Plain dyed tan

Defect

General over-all blotchy appearance, with small areas appearing lighter and darker than normal

Analysis

Examination showed that this blotchy effect was due to uneven pickage and distortion of the filling threads in numerous small areas. This condition was attributed to so-called "finger marks" caused by pressure of a worker's hands on the warp in the loom during weaving, with subsequent distortion resulting in uneven laying-in of the picks in the woven goods.

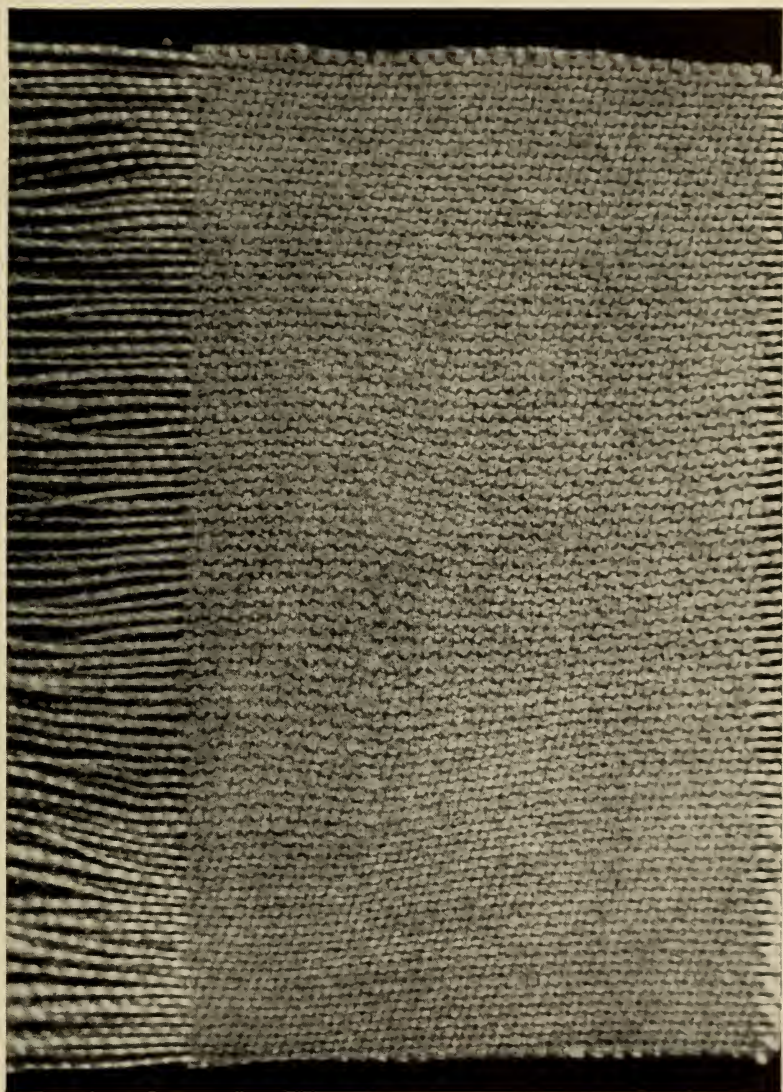


FIG. 39. Filling distorted by finger marks.

CASE 1-60. FOREIGN MATTER

Fabric

Underwear fabric

Construction

Count: 150×98

Warp: 75/50/3 bright acetate rayon

Filling: 75/30/35 Z bright viscose rayon

Finish

Plain dyed tea rose

Defect

Small particles of "foreign matter" woven into the fabric

Analysis

Microscopic examination of particles of the contaminating material showed that it consisted of woodlike splinters. Chemical tests, however, disclosed the fact that the "splinters" were soluble in acetone and reacted like cellulose acetate. It was concluded that this defect was due to bits of fused acetate-rayon filaments that accumulated on the bottom of the shuttle and were occasionally deposited and woven into the cloth. The acetate "splinters" probably came from warp yarn that was struck and chafed by the shuttle. The resultant bruise marks on the warp would not be seen in fabric dyed in pastel shades.

CASE 1-61. FILLING STREAKS

Fabric

Combination-yarn dress goods

Construction

Count: 60×54

Warp: 75/30 S viscose-rayon crepe, plied 18 turns S with
75/20 S dull acetate rayon

Filling: Same as warp

Finish

Plain dyed blue

Defect

Short light streaks in the filling

Analysis

Careful examination showed that the streaks were confined to the acetate component of the plied filling yarns. Microscopic analysis revealed a partial additional delustering of the acetate yarn in the streaky sections. Since it was obvious that there was no finishing operation which could have produced such a selective delustering effect, a study was made of every gray-mill manufacturing procedure where such a defect might have originated. It was finally decided that the damage could have been caused by drops of water condensing on the yarn during the steaming operation used for setting the twist in the plied yarn. Water spots on the acetate rayon when it was subjected to high temperatures, particularly where the yarn was in contact with the hot metal heads of the spools, produced a partial delustering of the surface. This was confirmed by making trials and deliberately introducing water drops on the yarn during the steaming, then weaving those packages of yarn in the filling of a piece of fabric properly identified. Laboratory dyeing of head ends disclosed the same type of defect.

CASE 1-62. BRIGHT WARP ENDS

Fabric

Lining twill

Construction

Count: 112×72

Warp: 150/40 bright acetate rayon

Filling: Same as warp

Finish

Plain dyed brown

Defect

Two single bright-appearing ends in warp

Analysis

Denier, filament count, twist, and rayon identification of the bright-appearing ends showed no abnormal condition. Single-strand elongation tests, however, showed the two ends in question to have abnormally low breaking strength and elongation and, in removing them from the fabric, it was found that they had much less crimp than adjacent normal warp ends. This defect was due to stretched warp ends probably caused by excessive tension during weaving. Theoretically, the denier of these ends should be slightly lower than normal, owing to the overstretching, but it has been found that changes in the stress-strain characteristics of the yarn are a much more reliable measure of overtensioning.

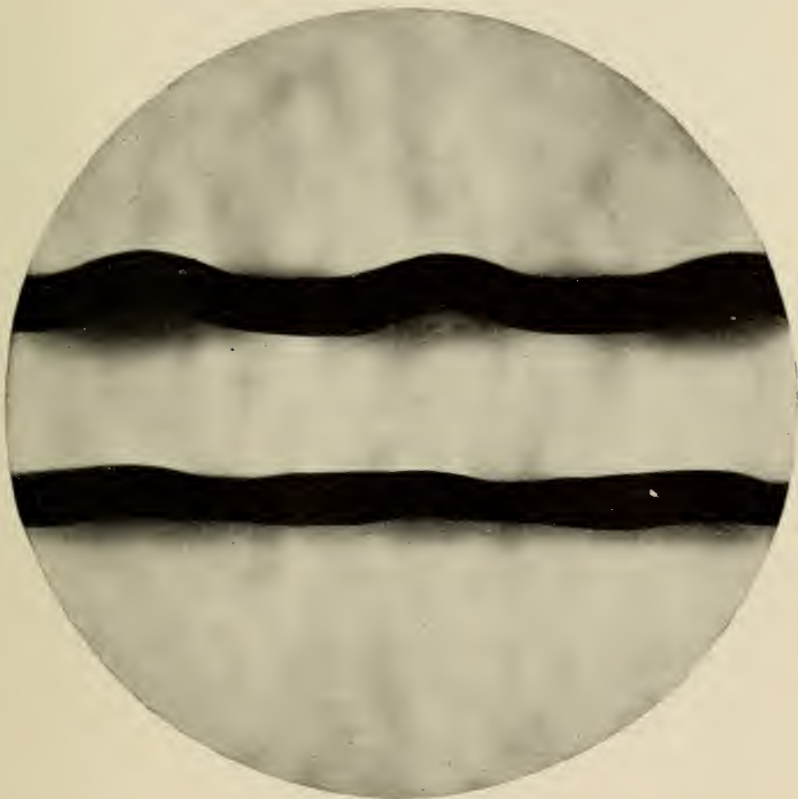


FIG. 40. Variation in yarn crimp.

CASE 1-63. FILLINGWISE CUTS

Fabric

Rayon-warp cotton-filled satin

Construction

Count: 240×66

Warp: 150/40 bright viscose rayon

Filling: 30/2 combed cotton

Finish

Plain dyed light blue

Defect

Several small broken places across width of the piece

Analysis

Examination of the sample submitted showed several spots where the warp yarns were broken, the break being exactly parallel to and along sections of the cotton filling yarns. On the cotton back of the fabric the filling yarn running parallel to the broken areas was dyed lighter than normal. Physical and chemical tests showed that the light-dyed filling yarn and the warp yarn in contact with the faulty filling were deteriorated chemically and the cotton yarns were very tender.

This defect was attributed to the presence of oily filling yarn containing small amounts of iron from contact with machine bearings. When the cloth was subjected to bleach, the iron acted as a catalyst, accelerating the oxidation and producing oxycellulose in the cotton filling yarn and in the rayon warp yarn through direct contact. The rayon yarns being much weaker when wet, and excessively tender in those sections, broke when the goods were finally finished.

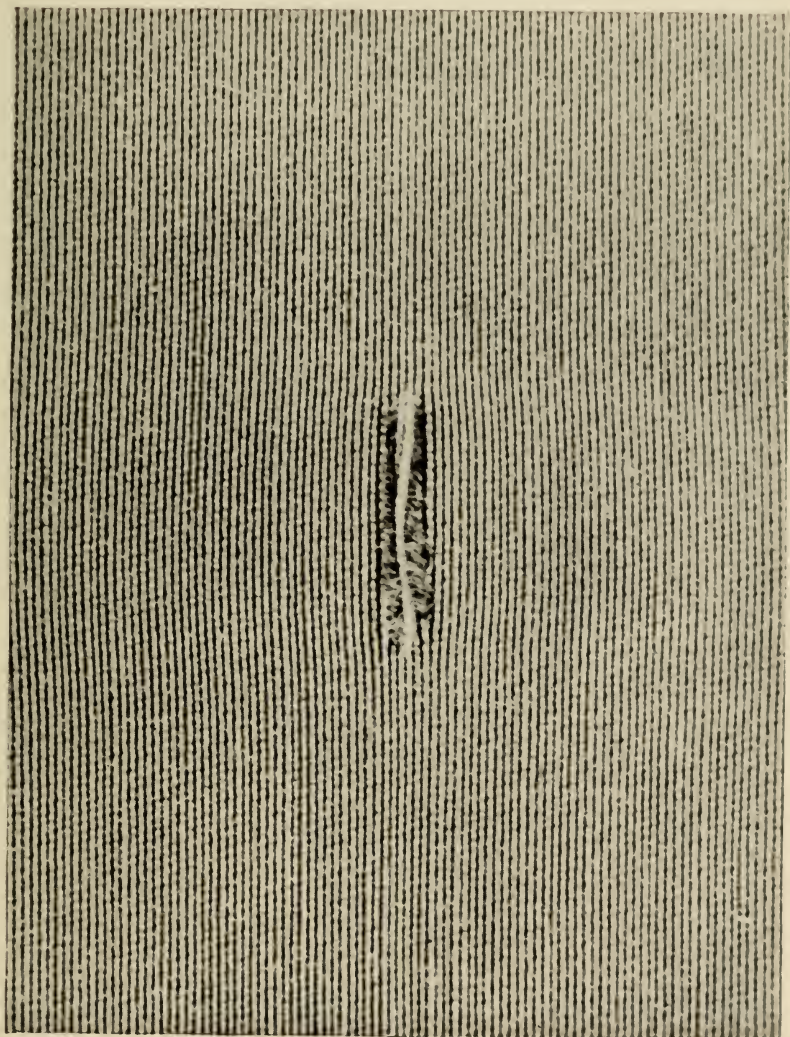


FIG. 41. Tendering in bleaching due to presence of iron.

CASE 1-64. WARP STREAKS

Fabric

Parachute-canopy fabric

Construction

Count: 110×76

Warp: 40/13 nylon

Filling: 60/20 nylon

Finish

Plain white

Defect

Continuous warp streaks across full width of sample

Analysis

It was found that the streaks appeared as bright ends at intervals in a regular pattern, repeating on every eighth end. Investigation showed that this construction had been slashed from eight section beams. Physical tests on the bright-appearing warp ends indicated that they were under greater tension than the remainder of the warp and this resulted in greater light reflection. The defect was attributed to excessive tension applied to one section beam during warping.

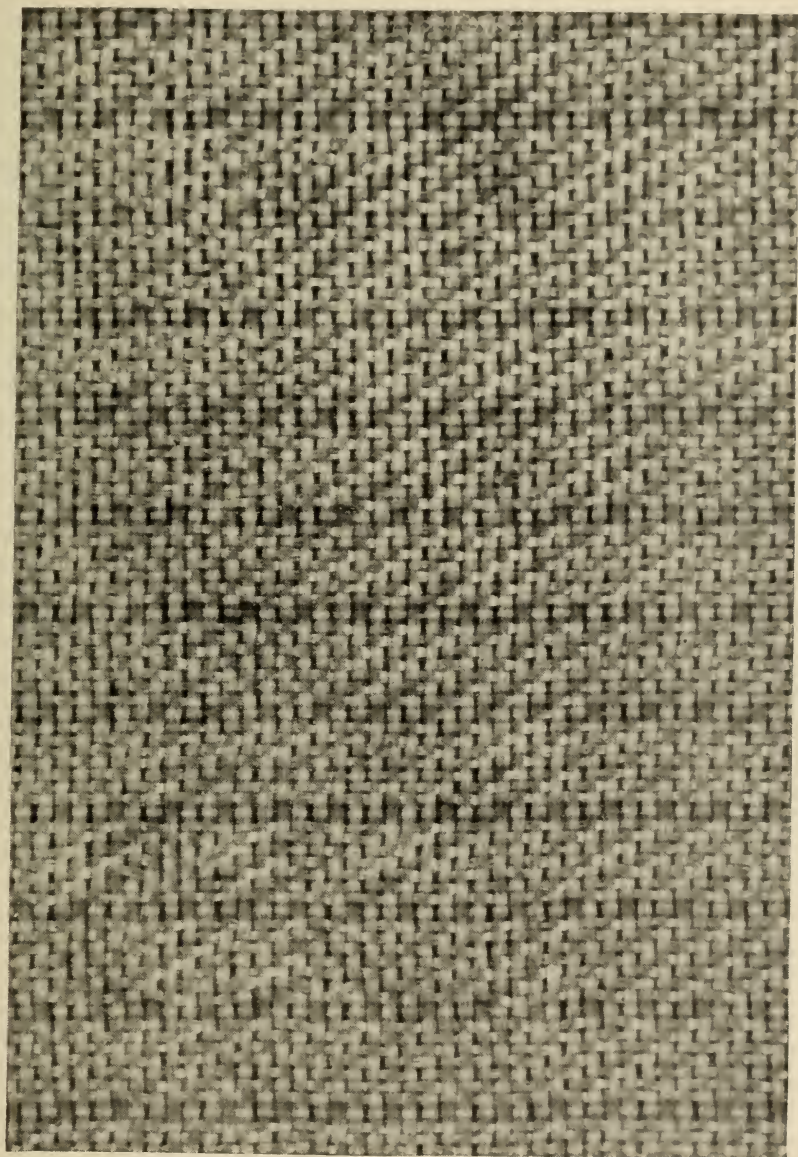


FIG. 42. Streaks due to tight section beam.

CASE 1-65. WARP STREAK

Fabric

Underwear French crepe

Construction

Count: 150×94

Warp: 75/50 bright acetate rayon

Filling: 75/30/35 bright viscose rayon

Finish

Plain dyed black

Defect

Single dull-appearing warp streak

Analysis

Analysis showed that the dull warp streak was due to the presence of three adjacent warp ends slightly chafed in weaving. The broken filaments resulted in reducing the luster of the damaged yarns.

This type of damage might have been due to roughness of a reed dent wire, or to a rough drop wire or heddle. The use of stainless-steel reeds is considered good insurance against injury to fine rayon yarns originating from rusty wires.

CASE 1-66. CROSS-DYED EFFECT

Fabric

All-rayon lining twill

Construction

Count: 112×68

Warp: 150/40 bright viscose rayon

Filling: Same as warp

Finish

Plain dyed gray

Defect

Slight cross-dyed effect, accentuating tendency to warp streaky appearance

Analysis

Rayon yarn identification, confirmed by the weaving mill's records, showed that two different makes of viscose rayon had been used in this fabric, the warp yarn having a higher dye index than the filling yarn. When the use of two different makes of yarn is unavoidable, experienced weavers are generally cautious in selecting yarns with approximately the same dye index. Such information either is obtainable from the yarn manufacturers or may be determined by laboratory dyeing tests.

A similar condition will result when cotton and viscose rayon are used in the same fabric. Because the cotton absorbs the dyestuff much more slowly, it will normally dye lighter than almost any of the viscose process rayons. This variation can be minimized by the use of special technique on the part of the dyer to slow down the pickup of color by the rayon until the cotton has had a chance to come up to shade.

CASE 1-67. DARK SPOT

Fabric

Twill dress goods

Construction

Count: 92×64

Warp: 150/40 dull viscose rayon

Filling: Same as warp

Finish

Plain dyed pink

Defect

Dark spot

Analysis

The so-called "dark spot" was found to be a dirty warp knot which resisted cleaning during normal wet processing of the fabric. Chemical tests revealed the presence of traces of iron, as well as unremoved soil. Laboratory scouring tests indicated that the finisher was not at fault in claiming inability to eliminate the dirty knots. The iron was apparently coming from small amounts of rust, which were picked up along with the unremovable dirt while the warp was passing through the reed or the heddles.

In certain cases in which the classification of such goods as suitable for white and light shades may command a premium price, it is sometimes possible for the finisher to use special scouring procedures which will result in removal of most of the soil in such dirty knots, but this special handling is necessarily more costly and necessitates extra charge by the finisher.

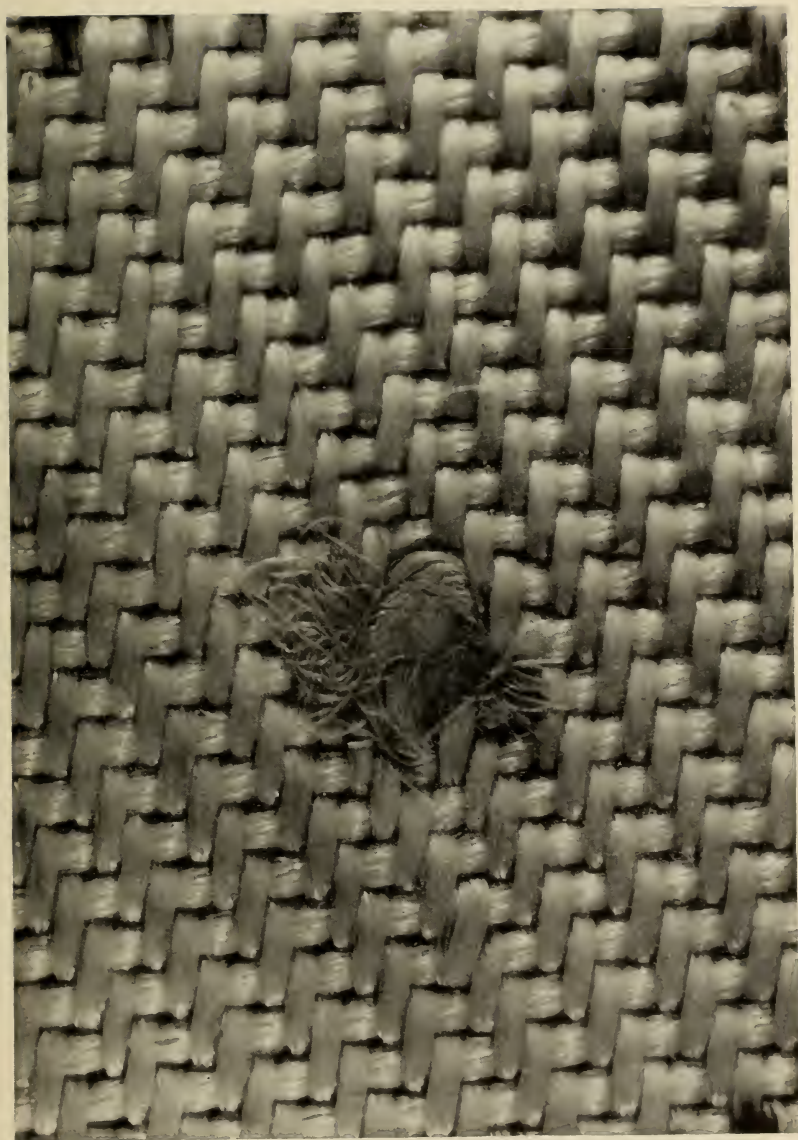


FIG. 43. "Spot" due to dirty knot.

CASE 1-68. DIFFERENCE IN APPEARANCE

Fabric

Novelty combination-yarn dress goods

Construction

Count: 56×52

Warp: One end of 100/60/50 S bright viscose rayon, ply-twisted S with one end of 150/40/3 S dull acetate rayon, alternating with one end of the same combination but all Z twist. Arranged Z, S, Z in one dent

Filling: 150/40/20 S dull acetate rayon

Finish

Plain dyed navy

Defect

Fabric delivered to customer differed in appearance from the original sample approval pieces since it showed none of the desired pronounced stripe or "rib" effect in the warp.

Analysis

Analysis disclosed that the fabric constructions were identical except for the twist direction of the filling yarn and the warp arrangement of S, Z, S combination in one dent, instead of Z, S, Z, as in the original. This difference in twist arrangement and reeding resulted in a less pronounced rib effect, which no finishing operation could correct.

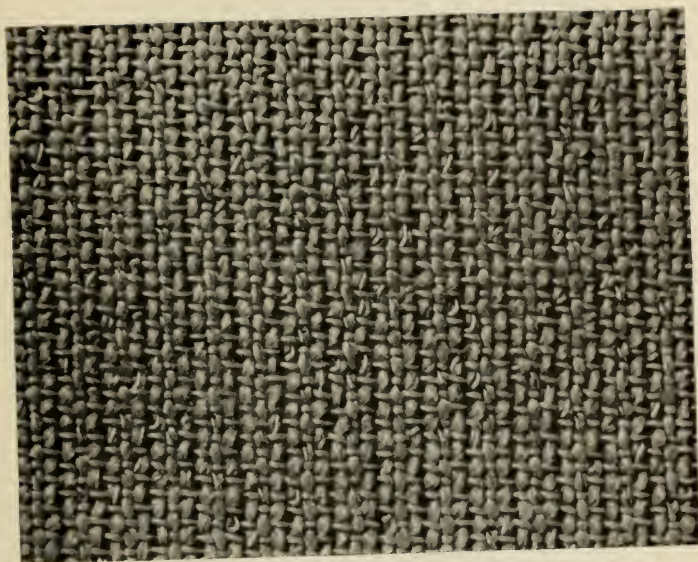


FIG. 44*a*. Normal—ribbed effect.

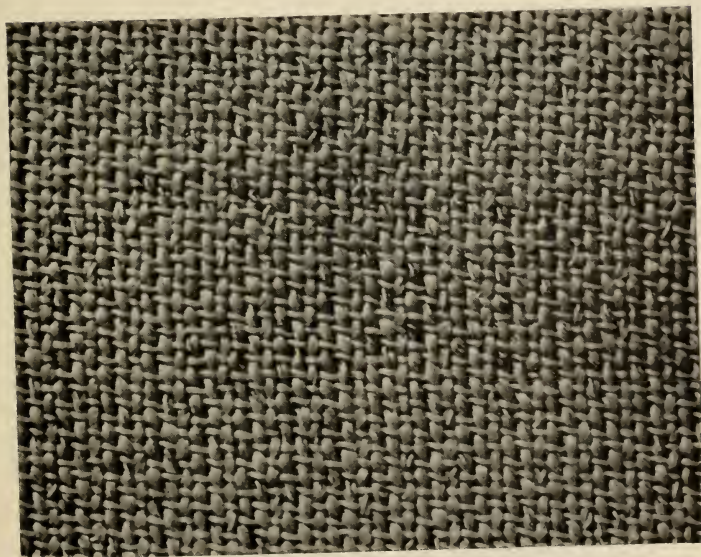


FIG. 44*b*. Defective—absence of ribbed effect.

CASE 1-69. FILLING STREAKS

Fabric

Combination-yarn dress goods

Construction

Count: 180×48

Warp: $75/20/1\frac{1}{4}$ dull acetate rayon

Filling: Two ends $100/60/50$ bright viscose rayon, plied 14 turns and woven two picks S and two picks Z

Finish

Plain dyed navy

Defect

Short light streaks in filling

Analysis

Microscopic examination revealed that the so-called "white filling streaks" were actually small sections of damaged warp yarns, the damage running parallel to the filling. This defect was found to be due to a bruising of the acetate warp yarns by the shuttle. The bruised sections resisted dyeing, which brought out the light streaks—particularly prominent in dark-dyed shades. These "shuttle marks" are generally noticeable in acetate-warp-yarn fabrics only, because of the somewhat soft or plastic nature of acetate yarns. The acetate is evidently slightly fused by the frictional heat of the fast-moving shuttle, while at the same time the filaments are ruptured. Such damage may be due to poor warp sizing where the protection against chafing is inadequate or, more often, to excessive picking action or a faulty shuttle. In some cases, a deeper plush covering on the shuttle race plate affords better protection of the warp ends from such damage.

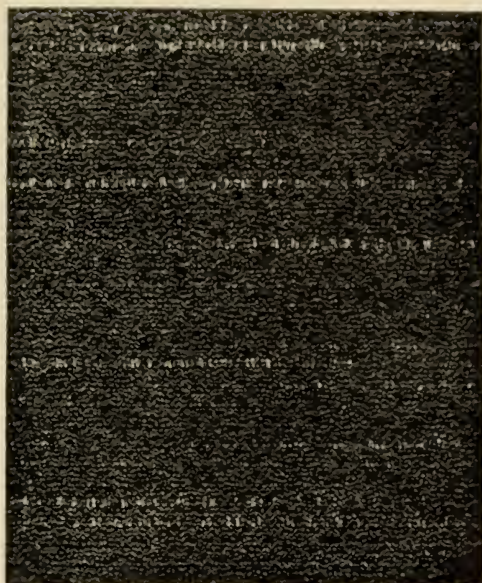


FIG. 45a. Streaks in fabric.



FIG. 45b. Warp yarns bruised by shuttle.

CASE 1-70. WARP STREAK

Fabric

Combination-yarn dress goods

Construction

Count: 54×44

Warp: 100/60 bright viscose-rayon crepe plied with 150/40
dull acetate rayon

Filling: Same as warp

Finish

Plain dyed light green

Defect

Single warp streak

Analysis

Analysis revealed that the rayon-crepe yarn in the single end in question was of the identical denier, filament count, and make as the remainder of the rayon yarns and had the proper twist, but was a semidull rayon instead of a bright rayon, dyeing slightly lighter and producing the streak as noted.

CASE 1-71. WARP STREAKS

Fabric

Lining twill

Construction

Count: 144×72

Warp: 150/40 bright acetate rayon

Filling: Same as warp

Finish

Plain dyed light gray

Defect

Dark warp streaks across the full width of the piece

Analysis

Microscopic examination showed a solid deposit on most of the warp yarns. Attempts to remove this deposit by laboratory desizing and scouring were unsuccessful. Since it was known that these goods had been warp-sized with a gelatin-base material, it was at first assumed that the sizing had been overdried or baked on in slashing, which would make it difficult to remove. Upon checking on the warp-sizing formula used, however, it was learned that a slasher foreman who was inexperienced in the use or properties of gelatin had taken precautions to prevent the formation of mildew by the addition of formaldehyde. Chemical reaction between the gelatin and the formaldehyde resulted in the formation of an insoluble mass on the warps before weaving.

CASE 1-72. WARP STREAK

Fabric

Novelty leno-weave dress goods

Construction

Count: 52×36

Warp: 150/40 dull acetate rayon plied S with 100/40 viscose-rayon crepe S

Filling: Same as warp

Finish

Plain dyed pink

Defect

Single warp streak throughout piece

Analysis

Analysis of the sample submitted showed that the single streak was due to the presence of a Z twist rayon-crepe end in one of the combination yarns, instead of all-S twist as specified. Furthermore, it was observed that the particular Z-twist yarn in question had a residue of a dark-colored tint, which made it even more prominent in the dyed fabric. However, the incomplete removal of the tint was considered to be of secondary importance, since the difference in twist alone would result in the appearance of a streak.

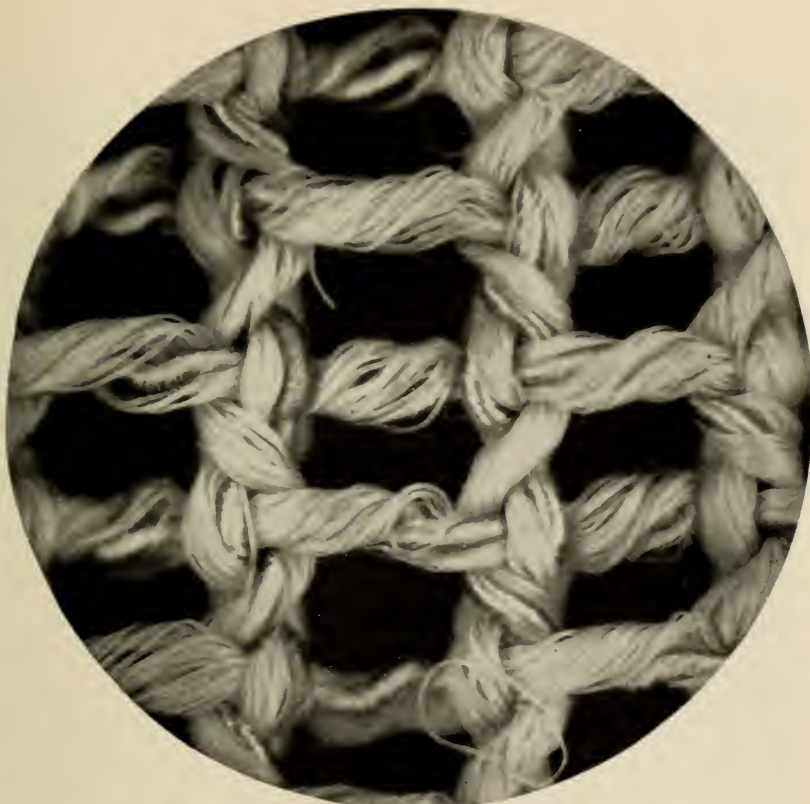


FIG. 46a. Streak due to single Z twist crepe yarn.



FIG. 46b. Normal—S twist crepe.



FIG. 46c. Defective—Z twist crepe.

CASE 1-73. WARP STREAK

Fabric

Spun-rayon novelty dress goods

Construction

Count: 38×42

Warp: 14/1 80% 1½-in. 1½-den. bright viscose rayon
20% 1½-den. bright viscose rayon cut to $\frac{3}{8}$ in.
to make nubby yarn

Filling: Same as warp

Finish

Plain dyed light green

Defect

Single darker green warp streak

Analysis

It was found that the single darker dyeing end was of a different size (32/1 instead of 14/1) and was composed of a blend of 50% 1½-inch 1½-denier bright viscose and 50% 2-inch 3-denier dull acetate, instead of as specified. Furthermore, chemical tests showed that the acetate fibers had been saponified, probably because of a causticizing treatment of the goods by the finisher, which might be considered a normal operation for what was supposed to have been an all-viscose fabric. As a result of this saponification, the foreign end became more noticeable than the off-size alone would indicate, owing to the fact that the converted acetate dyed darker than the normal all-viscose yarns.

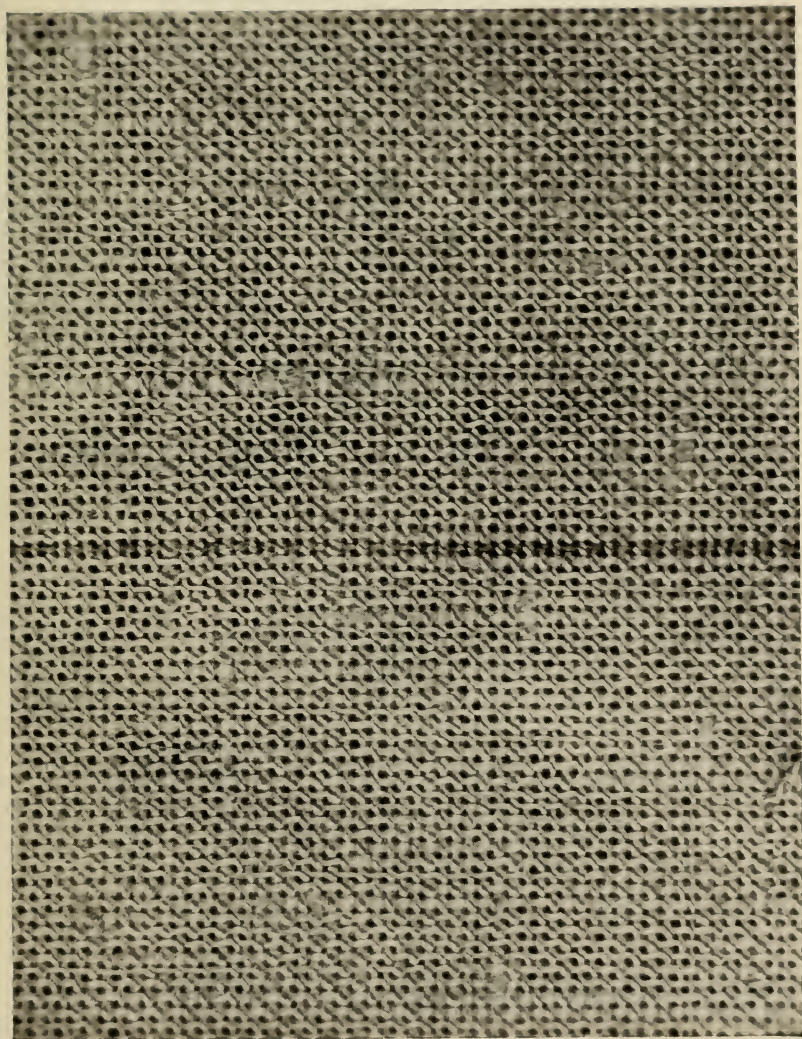


FIG. 47. Foreign end containing acetate saponified prior to dyeing.

CASE 1-74. BROWN STAINS

Fabric

Spun-rayon dress goods

Construction

Count: 96×50

Warp: 20/1 75% 2-in. 3-den. dull viscose rayon

25% 2-in. 1½-den. dull viscose rayon S twist

Filling: Same as warp but Z twist

Finish

Plain dyed yellow

Defect

Numerous brown stains in finished goods

Analysis

Inspection of a number of pieces showed no regular pattern to the defect, the stains being, in general, fairly small and scattered. Chemical tests revealed the presence of iron. By a study of a great many of the discolored areas under the microscope it was discovered that there were small bits of fine wire spun into the yarn in four or five different places. Further investigation revealed that these wire particles came from the steel wool used in floor-cleaning machines recently put into use in the mill and had been accidentally discharged through a hole in the dust-collecting bag, so contaminating some of the rayon stock prior to its being spun. The metal particles rusted when the goods were processed at the finishing plant and batched up while wet, and most of the stains were due to mark-offs from the original heavily rusted areas. The finisher was able to correct this defect by treatment of the goods with oxalic acid, to remove the stains before dyeing.

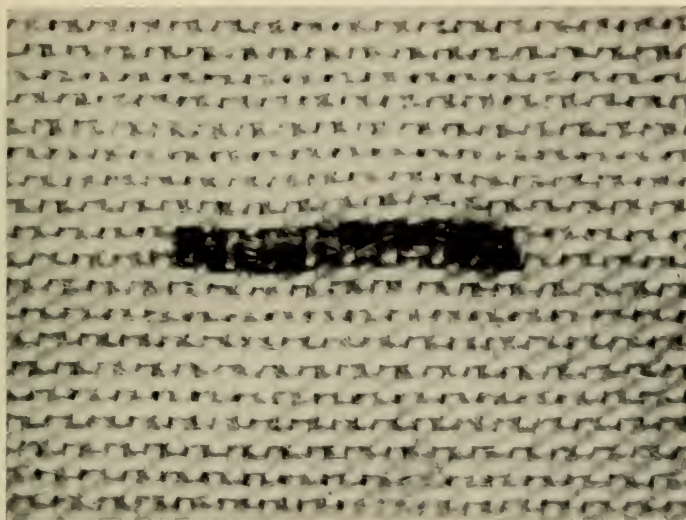


FIG. 48a. Stain in dyed fabric.

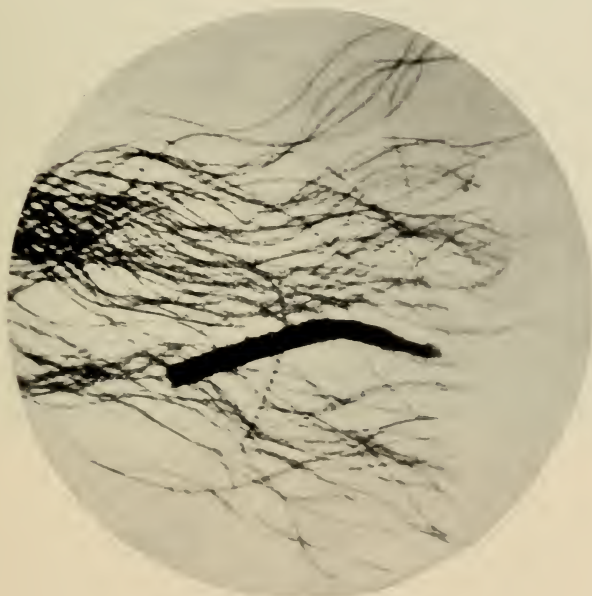


FIG. 48b. Wire in spun yarn.

CASE 1-75. WHITE SPECKS

Fabric

Spun-rayon sheer dress goods

Construction

Count: 42×42

Warp: 14/1 85% 1½-in. 1½-den. bright viscose rayon
15% viscose-rayon nubby stock

Filling: 14/1 75% 1½-in. 1½-den. bright viscose rayon
25% viscose-rayon nubby stock

Finish

Plain dyed navy

Defect

White specks throughout piece

Analysis

The white specks, which were found to be present in both warp and filling yarns, consisted of bits of undyed real-silk thread. Since the nubby stock was prepared from garnetted yarn waste, it was concluded that the small pieces of silk were present in that stock as it was delivered to the mill. It was possible to use this fabric by redyeing it, adding a dyestuff to make the silk the same shade as the rayon.



FIG 49. Specks due to undyed silk thread.

CASE 1-76. WARP STREAK

Fabric

Spun-rayon dress goods

Construction

Count: 34×34

Warp: Novelty yarn composed of one end of 30/1 spun-viscose-rayon nubby yarn, ply-twisted with one end of 75/20 dull acetate rayon

Filling: Same as warp

Finish

Cross-dyed blue (viscose) and white (acetate)

Defect

Single dark-dyed end in warp

Analysis

Analysis showed that the dark-dyed end was composed of two plies of all-viscose spun rayon, instead of one end of viscose and one of filament acetate, as specified. It was later determined that this was a selvage end, which had accidentally been woven into the body of the fabric. Being all viscose, it was dyed solid blue and was revealed as a dark streak.



FIG. 50. End composed of all-viscose rayon.

CASE 1-77. WASTE IN FILLING

Fabric

Combination-yarn dress goods

Construction

Count: 64×62

Warp: 75/30 S bright viscose-rayon crepe ply-twisted with
75/20 dull acetate rayon

Filling: Same as warp

Finish

Plain dyed navy

Defect

Small bunches of "waste"

Analysis

The bunches of so-called "waste" in the filling were found, by microscopic analysis, to be small bunches of opossum-fur fibers. To aid in providing satisfactory tension on rayon filling yarn as it leaves the shuttle, it is common practice to place a piece of fur along the shuttle sides and bottom. Opossum fur is one type used frequently, and the defect in this fabric was apparently due to some loose fur fibers' becoming trapped in the filling during weaving.

CASE 1-78. WARP STREAKS

Fabric

Spun-rayon slub broadcloth

Construction

Count: 102×52

Warp: $30/1$ $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: $18/1$ 90% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon
10% nubby rayon stock

Finish

Plain dyed light blue

Defect

Single end warp streaks across full width of several pieces

Analysis

Laboratory stripping and redyeing resulted in no improvement. Inspection under ultraviolet light showed a difference in fluorescence between the light- and dark-dyed warp ends.

Further investigation revealed that the weaving mill, in an attempt to improve the running qualities of this fiber, had applied an oil to one lot, prior to opening and carding. Yarns spun from this lot were inadvertently mixed in warping with yarns spun from the same make of fiber processed as received. Although the oil was of a type used before and found to give no trouble, it was evident that previously there had been no mixing of oiled and unoiled lots, so that it was not known for certain whether the oil was not completely removable in finishing. Or it was possible that this particular oil was slightly different in its chemical properties because of oxidation or some other form of deterioration in use, resisting complete removal in scouring.

CASE 1-79. YELLOW WARP STREAKS

Fabric

Crepe-backed satin dress goods

Construction

Count: 264×70

Warp: 75/40 semidull viscose rayon

Filling: 125/60 bright viscose rayon crepe, 2 S and 2 Z

Finish

Plain dyed black

Defect

Numerous short yellow warp streaks

Analysis

Examination showed that the short yellow threads began and ended at knots. It was found that they were lengths of 75-denier acetate yarn which were apparently pieced in on the loom by mistake. In the dyeing of the viscose rayon black, the acetate became stained a bright yellow.

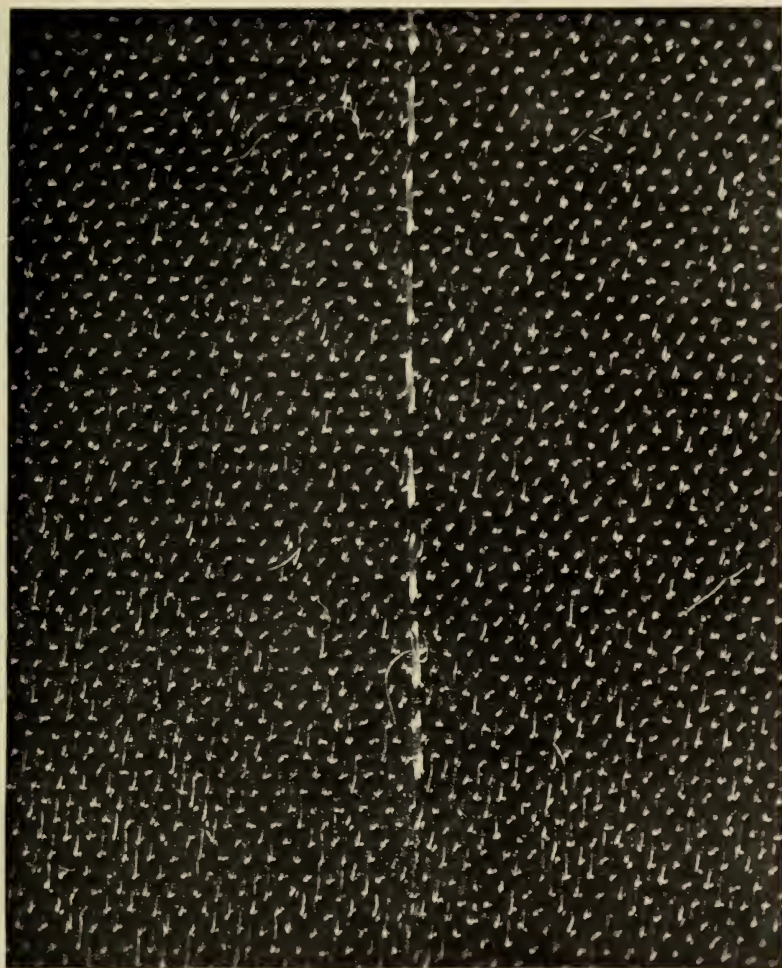


FIG. 51. Mixed piecing during weaving.

CASE 1-80. DISCOLORED FILLING

Fabric

Taffeta dress goods

Construction

Count: 200×64

Warp: 75/20 bright acetate rayon

Filling: 120/40 bright acetate rayon

Finish

Plain dyed light blue

Defect

Irregular dark bands varying in width up to 3 inches across the fabric

Analysis

Examination showed a peculiar pattern effect starting at the shuttle changes. Laboratory stripping and redyeing resulted in only partial elimination of the bands. Microscopic analysis disclosed no solid deposit of any kind on the yarns in the discolored sections. After checking further with the mill, it was determined that this condition was caused by the transfer of some undried fresh varnish on the wooden filling bobbins to the yarn in question, which was lying next to the wood. This is the type of defect which would be practically impossible to trace without the cooperation of the mill. Chemical analysis of the yarn would be extremely difficult, since the contaminating varnish would be, by the time of analyzing, completely oxidized and hardened and the quantities necessary to produce the staining effect were very small.

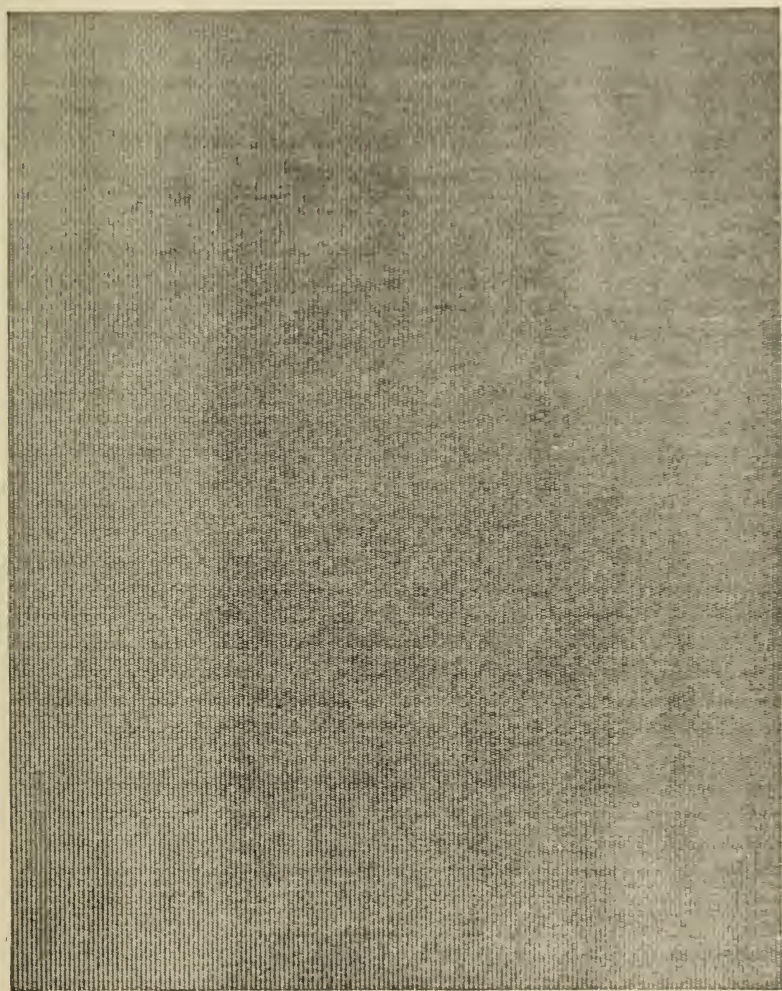


FIG. 52. Yarn stained by bobbins varnish.

CASE 1-81. WARP STREAK

Fabric

Automobile slip-cover fabric

Construction

Count: 80×46

Warp: 300/60/3 bright medium-tenacity viscose rayon

Filling: Same as warp

Finish

Plain dyed maroon

Defect

Single dark warp streak

Analysis

Denier, filament count, and twist of the dark-dyeing end were the same as the remainder of the warp yarns. Single-strand breaking-strength and elongation tests, however, showed that end to have a lower strength and higher elongation than the normal warp yarns. These tests identified it as being a regular-tenacity viscose yarn introduced into the warp by mistake and having a different dye affinity from that of the medium-tenacity yarns of the same manufacture, size, and filament count.

CASE 1-82. MARKING OFF

Fabric

Faille taffeta dress goods

Construction

Count: 174×72

Warp: $74/34$ bright acetate rayon

Filling: $300/80$ dull acetate rayon

Finish

Plain dyed lavender

Defect

Fabric showed light streaks or "mark-offs" when fingernail was rubbed across surface, or if fabric was crushed.

Analysis

It is not uncommon to find a condition of this kind caused by finish on rayon fabrics, and it was at first suspected that this was the cause of the ease with which this material showed "mark-offs," or crush marks. However, laboratory scouring did not eliminate the fault, which proved that the finish was not responsible for the condition. Close examination disclosed the fact that the filling yarns were dyed much lighter in shade than the warp yarns, which was to be expected when it was learned that the fabric was woven with dull yarns in the filling and bright-luster yarns in the warp. The marking off was evidently due to a disturbance or re-arrangement of the warp, which resulted in the lighter dyed filling's showing through unevenly. While some shades would show the condition more than others, the basic fabric construction was considered responsible for this defect.

CASE 1-83. HOLES

Fabric

Spun-rayon broadcloth

Construction

Count: 128×68

Warp: $30/1$ $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: Same as warp

Finish

Plain dyed green

Defect

Numerous small breaks in the filling

Analysis

The finished goods showed numerous places where single filling yarns were broken. Careful examination of a number of pieces of the gray goods revealed the presence of several kinked filling yarns which protruded slightly above the cloth surface. By checking with the finisher, it was learned that the gray goods were singed before processing. It was evident that this operation was causing a burning of the protruding loop, with the subsequent production of filling breaks and holes.

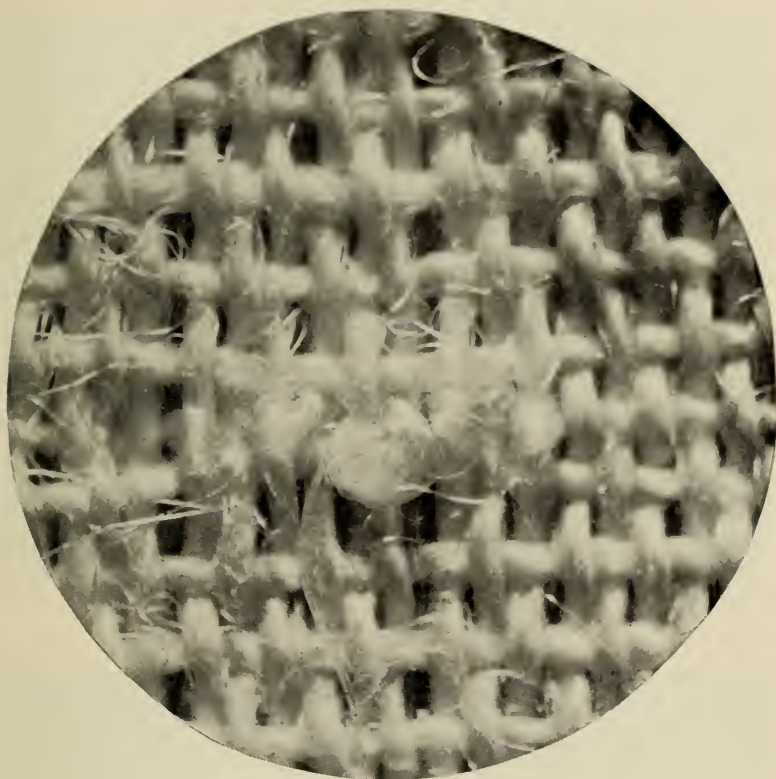
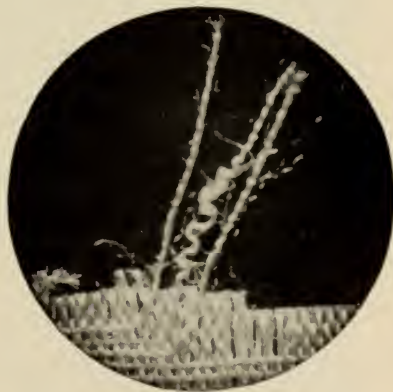
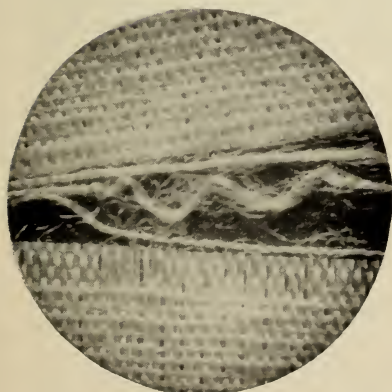


FIG. 53a. Hole due to filling break.



FIGS. 53b and c. Kinks in filling yarn.

CASE 1-84. BREAKS IN SELVAGE

Fabric

Dress goods

Construction

Count: 100×68

Warp: $36/1$ $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: Same as warp

Finish

Gray goods

Defect

Finisher claimed selvage breaks and rips during processing.

Analysis

Examination of a sample gray-goods cutting showed distortion of the selvage opposite the shuttle-box side of the fabric, along with a number of broken or partially cut filling yarns. This defect was apparently produced in the weaving and was undoubtedly responsible for the difficulty encountered by the finisher.

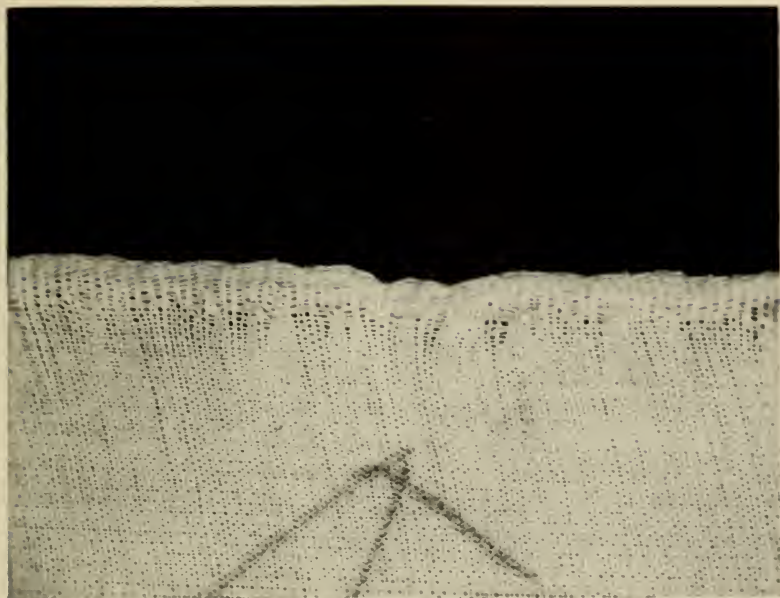


FIG. 54a. Poorly woven selvage.

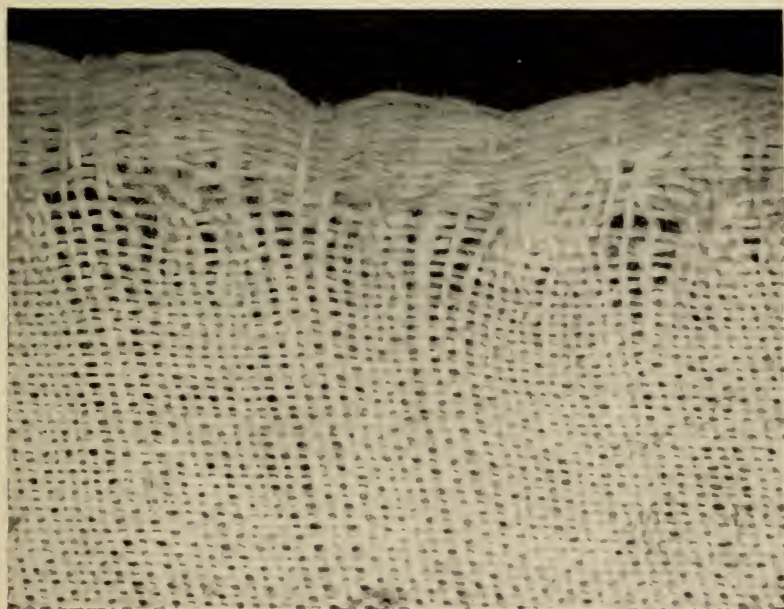


FIG. 54b. Same under higher magnification.

CASE 1-85. WARP STREAK

Fabric

Underwear French crepe

Construction

Count: 150 \times 94

Warp: 75/50 acetate rayon

Filling: 75/30 voile-twist viscose rayon

Finish

Boiled-off white

Defect

Streaky warp, presenting a dirty appearance

Analysis

Microscopic examination showed that this defect was due to traces of unremoved blue tint on a number of the warp ends. It was determined by laboratory tests that normal-soap scouring and even alkaline hydrosulphite solution were not effective in removing this discoloration completely, it being necessary to resort finally to the use of a hypochlorite bleach. Similar tests were made on cuttings of gray goods supplied by the finisher, and the laboratory findings were confirmed. Evidently the tinted yarn as used by the weaver was not fugitive in normal wet processing of the woven fabric, and it was necessary for the mill to reimburse the finisher for the additional bleaching operation.

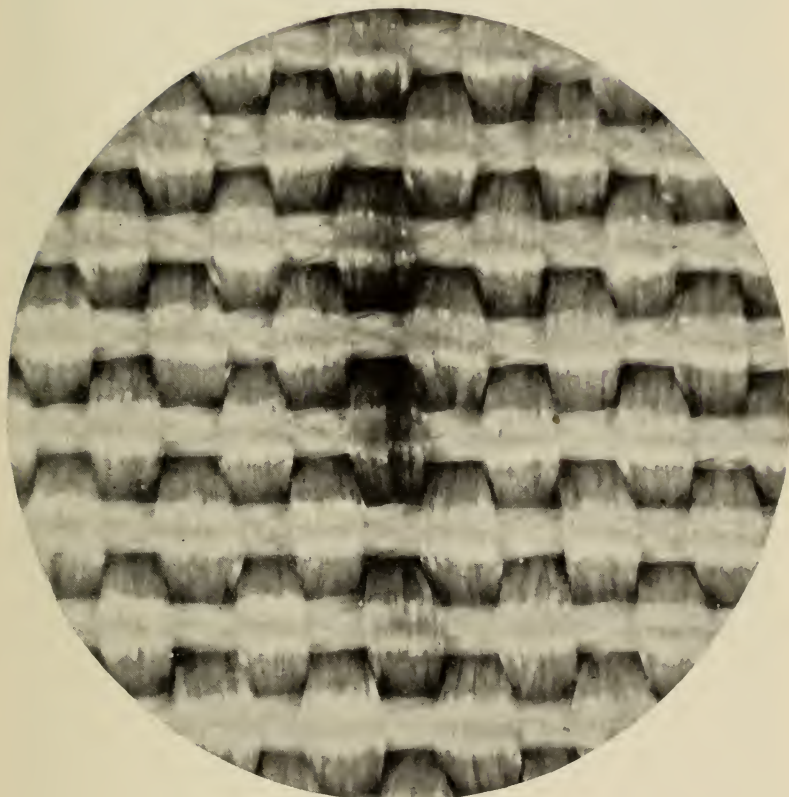


FIG. 55. Nonfugitive tint on warp yarn.

CASE 1-86. FILLING STREAKS

Fabric

Taffeta dress goods

Construction

Count: 220×52

Warp: 100/40 bright acetate rayon

Filling: 10/1 combed cotton

Finish

Plain dyed light blue and given moire finish

Defect

Short light streaks running about 15 inches from one edge

Analysis

Examination showed that this defect was due to a chafing of short sections of filling yarn during weaving. This was probably caused by a poorly adjusted picking motion, which caused the shuttle to rebound and rub on the yarn as it sloughed off during weaving, producing a condition commonly known as "box marks."

This condition should not be confused with "shuttle marks," although the appearance in the finished goods is somewhat similar. In the case of "box marks," the damage is usually confined to one area running parallel to the selvage.

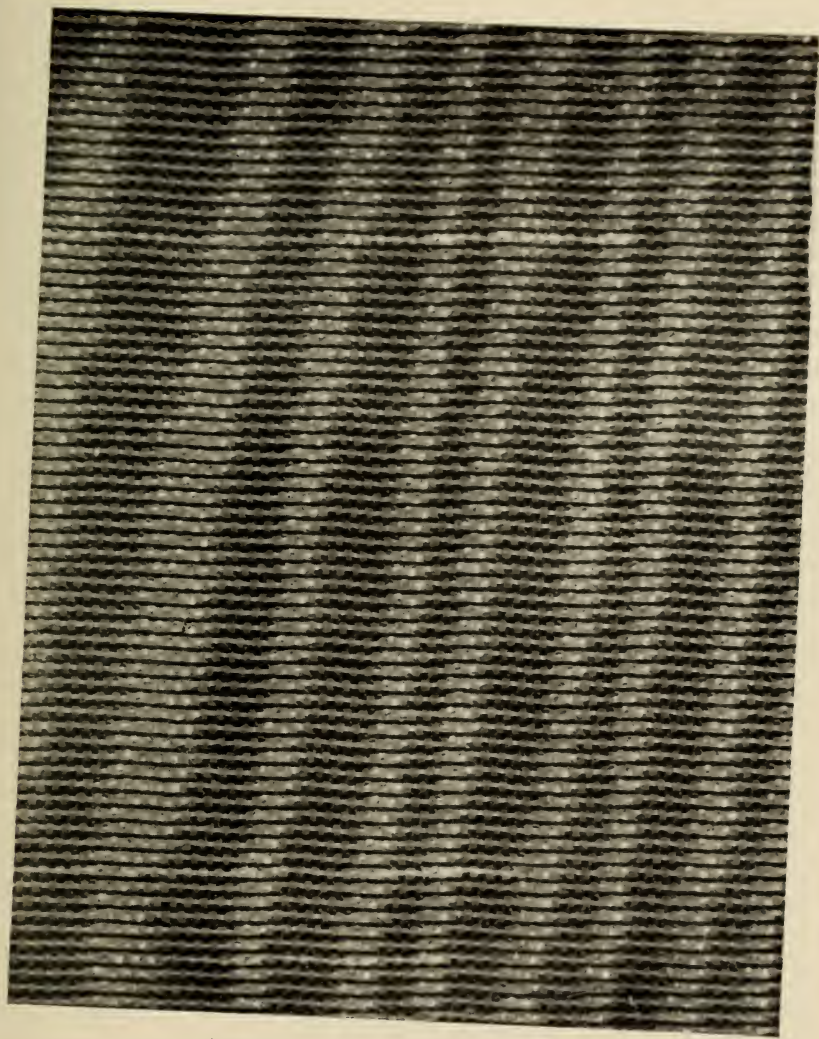


FIG. 56. Filling chafed by shuttle.

CHAPTER 2

DEFECTS IN MAN-MADE FIBERS AND YARNS

In spite of the noteworthy progress made by domestic manufacturers of man-made fibers and yarns during the comparatively short period of their existence and growth, it is only natural that from time to time certain latent defects will appear in the weaving mills or after the goods are dyed and finished. One who has had the opportunity to work in a rayon manufacturing plant, or even an intelligent layman who has observed in a casual manner the numerous complex steps through which the raw basic cellulose is converted into a finished yarn can well appreciate the many precisely controlled operations which may, through the slightest deviation by carelessness or human error, result in minute physical or chemical differences which eventually show up as "faulty" rayon.

Those who have occasion to deal with man-made fibers or yarns in cloth manufacture or processing are familiar in a general way with the exact control exercised by highly skilled chemists and engineers, starting with the analysis of the pulp and chemicals as received and carrying through to the physical and dyeing tests of the final product. A number of yarn producers operate costly pilot plants to give them firsthand information on the performance of their products in a practical way. No rayon manufacturer who is building a sound business for the future can afford to ship willfully merchandise which he suspects may fail to pass every known test to ensure good winding, warping, slashing, and weaving, and finally, first-class dyeing and finishing. Rayon staple, of course, must be evaluated for its uniformity, opening, carding, drawing, and spinning qualities, as well as its dyestuff affinity. Nevertheless, imperfect yarn or fiber will occasionally be detected in the weaving mill or in the finished fabric; and all our domestic manufacturers, in their sincere

desire to make corrections and improve future deliveries, are quick to recognize and acknowledge responsibility for such defects when they are called to their attention.

The examples of defects which are described in the following pages are taken from the accumulation of years of production covering the output of many manufacturers and numerous weaving mills and finishing plants. Notwithstanding the fact that in some cases a single defect may have been responsible for damage to thousands of yards of goods, at the same time it must be remembered that the total poundage of defective yarn which gets into fabric is an insignificant fraction of the total turned out by the industry.

A general classification of the types of defects in man-made fibers and yarns is as follows:

1. Physical
 - a.* Denier
 - b.* Filament count
 - c.* Twist
 - d.* Cross section
 - e.* Luster
 - f.* Tensile strength and elongation
 - g.* Broken filaments
 - h.* Miscellaneous
2. Chemical
 - a.* Degraded cellulose
 - b.* Finish and surface deposits
 - c.* Dyeing characteristics

There would be nothing gained by an attempt to describe in all cases the probable causes of such faults. The producer, like the weaver or the dyer, is thoroughly familiar with the job he is doing; and it is of no great concern to the spinner, the weaver, the converter, or the consumer to discover exactly what went wrong to make the final product a defective yarn. There are cases, however, in which there is little doubt as to the cause of the condition, and these will be mentioned as a matter of academic interest or in order that the user will have a better under-

standing of a few of the difficulties encountered by a yarn supplier.

Physical Faults

The following paragraphs describe some of the more common deviations from the normal physical properties of fibers and yarns or damages of a mechanical nature which may lead to the production of substandard quality fabrics.

Denier Variations. Apart from simple mixtures of different yarn deniers in the same shipping case, with or without proper labels on the original packages, variations in yarn denier within one package or from one package to another will result in imperfections in the warp or in the filling of woven goods. Denier variations are not discovered very frequently in warps, probably because the condition is not likely to be readily detected or to result in degrading the finished fabric. On the other hand, when such uneven yarn is used in the filling, a variation of as little as 5% may show up as a filling change or band in certain constructions.

Periodic Denier. This condition is readily noticeable in the filling, in particular, because it produces a wavy or chattery appearance in a somewhat regular pattern. It is described as "periodic denier," because the thick and thin places, due respectively to high and low deniers, will occur at regular intervals or periods. The over-all denier of large lengths of yarn will be found to be uniform. Since many readers will recall that a novelty "thick-and-thin" yarn, with extreme variations in denier, is produced by several manufacturers; and since it is generally known that such yarns can be made by intentionally feeding varying amounts of spinning solution to the spinnerettes, it is no great disclosure to state that the defective periodic denier is caused by a similar, but unintentional and uncontrolled variation. Incidentally, the dyeing of fabrics which contain first-quality thick-and-thin yarns has been known to present difficulties in some weaves and colors, because of the natural tendency of the coarser filaments in the thick portions to dye much darker than the finer filaments in the thin sections. This

dyeing difference is again brought to attention in the following discussion of filament count.

Filament Count. Yarns which have the same denier but different filament counts and which come from the same manufacturer will, in most instances, show up as darker or lighter dyeing ends in the warp or as bands in the filling. In extreme cases, the condition will be apparent in the gray, before dyeing. It is important to stress the fact that reference is made to the yarns from the same producer, because it is possible that a higher or a lower filament count of the same denier in one make of yarn will dye to the same apparent depth of shade as that of different filament size in another manufacturer's yarn. This is due, of course, to the fact that the so-called "dye index" of one make of yarn may very well be quite different from that of the many competitors.

In this category there is, first, the mixing of two yarns by the shipper or the weaver; as for example, a 150-denier 40-filament yarn with a 150-denier 60-filament yarn, both being of normal, first-quality production. Obviously, in the analysis of a piece of fabric, it is impossible to conclude with any degree of assurance whether the weaver or the rayon producer introduced the mixture. If the condition occurs in the filling and there are very few such bobbins in the entire lot of goods, it is reasonable to suppose that the mill is at fault, as any single package delivered by the yarn producer would make a great many such filling bobbins, unless it were detected and culled out at the mill during the quilling operation. Should such a mixed end get by in the warp through warping, slashing, and weaving, it is evident that thousands of yards of fabric could be degraded as seconds from only a few pounds of yarn.

A second typical off-filament-count yarn fault is that of "low filaments," in which the number of filaments is appreciably lower than specified and is definitely not a regular production number from any manufacturer, such as 150/17 instead of 150/40. The coarser individual filaments result in less cover in the fabric, producing a condition which is frequently visible in the gray state; and in dyeing, the coarser filaments normally dye much darker, causing a dark streak in the warp or band in the filling.

Where the difference in the number of filaments is very great, the coarser filament yarn will also be much harsher and less pliable than the finer filament yarn. This fault is usually attributed to a clogged spinnerette, in which the constant flow of solution being pumped to the spinning jet results in the same over-all denier size, but the reduced number of holes yields filaments which are individually heavier.

A third example of "low filaments" may be due to breakage of filaments in the handling of a perfectly normal yarn. This damage may be effected in any operation up to the time of or even during weaving, and is generally revealed by the appearance of fuzzy ends protruding through the cloth or, if the condition is extreme, by the appearance of thin yarns and thin places in the woven goods. The unbroken filaments in such yarns, being of normal first-quality production and uniform in size, do not dye any differently and do not otherwise exhibit any abnormal characteristic except a lower tenacity, in proportion to the number of broken filaments.

Twist. Unless the yarn has passed through some mill operation to insert additional twist or to reduce the twist, as may be the case in reverse twisting of plied yarns, comparatively small variations in twist of yarns delivered to the mill will often show up as flaws in the woven fabric. This may be due to slightly higher twist, giving a thinner or a more compact yarn with less cover, or it may be due to a lower twist, giving a fuller yarn with more cover than the normal.

Occasionally, through some operation in twisting at the rayon plant, peculiar twist variations may occur, such as very short sections where high twist or kinks are inserted. Another unusual condition which has been observed is that in which a single filament is wrapped around the remainder of the yarn in spiral fashion, the constricted or bound yarn giving the appearance of a streak in the fabric.

Cross Sections. The study of filament cross sections is truly a subject for the rayon research chemist or student of rayon-spinning phenomena. In the viscose process, the holes in the spinnerettes are usually round in contour; but through a multitude of factors, ranging from spinning-solution composition

and viscosity to spinning-bath content and temperature and spinning speeds, the final viscose filament is characterized by a serrated-edge contour. In some instances, particularly in highly stretched spun yarns, the serrations disappear and the contours begin to approach the circular. This circular contour is usually typical, too, of cuprammonium-process yarns, nylon, and the protein-type fibers which have been produced commercially. In the distinctive serrated-edge type of viscose filaments, it is possible at times to identify the make of yarn by careful study and comparison of the filament shape alone, although in recent years there has been a marked similarity in the yarns of several different producers.

Where divergence from the standard of a single manufacturer in the same denier and filament count is detected, the resultant yarn very often has a distinctive appearance resulting from differences in light reflectance or abnormal dyeing characteristics. In the case of the cellulose acetate type of yarns their filament contours are usually different from most viscose rayons, except in the very fine-filament yarns. A fault occasionally encountered is a deviation from the bulbous or cloverleaf type of cross section to that of an abnormally elongated, "dumbbell," "dog-bone," or flat-type filament. Acetate-rayon yarn, if it contains a large number of such abnormally shaped filaments, usually appears as a lighter or brighter streak or band, owing to more light reflection from the comparatively large, smoother filament surfaces. Attention is called to the fact that such flat filaments are not always indicative of faulty yarn, as they may be made deliberately and represent a perfect product. This was done by one viscose manufacturer several years ago, working on the theory that the flat, ribbonlike filaments provided a yarn with more covering power. Also, it was characteristic of the regular production of Lustron cellulose acetate yarns, one of the first produced in this country, many years ago. Vinyon yarns, too, have been made with this type of cross section, as have experimental ethyl cellulose yarns.

There have been known instances when two yarns from the same producer showed what appeared to be cross-section abnormalities, yet the yarns exhibited no difference in dye index

or physical characteristics which affected the appearance of the woven cloth. On the other hand, it is not unusual to find two yarns showing no perceptible difference in filament cross sections, yet having marked differences in dyestuff absorption or dyeing rates. Hence, too much emphasis cannot be placed on the fact that the study and interpretation of filament cross sections is an art for the experienced microscopist and not for the novice who is looking for trouble.

Luster. Variations in luster are, of course, serious; but they are not always easy to detect. In rayon-producing plants, routine control measurements may be made by extremely sensitive photoelectric instruments, actually revealing differences so slight that they cannot be detected by ordinary visual examination in either yarn or fabric. Luster differences may be traced to cross-sectional differences, as indicated above; to slight abnormalities in the clarity of the spinning solution; or to variances in the finish used on the yarn. In delustered, or dull, yarn it is more likely to be due to slight differences in the amount, particle size, or distribution of pigment delustrant. Except in the case of fairly large differences, such as may be sometimes seen in the yarns of two different manufacturers, here, too, the technique of a skilled microscopist is needed, although a careful chemical analysis may reveal significant deviations from the normal.

Tensile Strength and Elongation. The simple tenacity and elongation characteristics of any one yarn may show such abnormalities as excessively low breaking strength or high or low elongations ultimately resulting in defective fabric. Yarns which show lower than normal yield points when subjected to strain or excessive elongations at low loads have been found to be responsible for the production of shiners or stretched filling during quilling or weaving; or they have come to light as stretched or tight ends in warps, when mixed with normal reacting ends. Stretched yarn is a defect of fairly frequent appearance, and, because the excessive strain might have been applied during some such process as coning by the yarn producer or any number of other operations, such as quilling or warping by the weaver, it is often the cause of considerable con-

troversy between the weaver and the yarn manufacturer. It is sometimes possible to fix definite responsibility or to trace the true cause by determination of the "repeat," if the stretched yarn shows a patterning in the cloth, or by extensive experiments in which the producer and the weaver work cooperatively in an honest effort to find the cause and to eliminate it.

Variations in the load-elongation curves of rayon yarns as received by the weaver often account for an uneven or streaky condition in the warp of woven fabrics. Single-strand breaking-strength and elongation tests may show exactly the same total elongation at exactly the same breaking load in two samples of yarn. However, if the test is made on a machine that has provision for recording the stress-strain diagram, particularly under a constant rate of loading, it may be discovered that, at certain increments of loading, the strain or elongation is appreciably greater or less in one specimen than in another. When two or more such packages of yarn having these differences in characteristics are warped, slashed, and woven, the finished fabric is likely to contain streaks which would be difficult to trace unless one had access to the results of tests on the original yarns. In this case, it would appear that the fault, as described, would be the result of some ends' stretching more than others when a uniform load or tension was applied as in normal warping or slashing. The streakiness probably appears because some ends are under greater tension than others or are slightly reduced in size (cross-sectional area) than adjacent normal ends.

Broken Filaments. Broken filaments produced through some mechanical damage—chafing, for example—are often serious enough to bring about the degrading of woven fabrics. Yarns which have very low twist or which are composed of very fine filaments are naturally most susceptible to this kind of damage. In the case of warp yarns, ruptured filaments in a number of single ends may pass unnoticed, owing to the fact that the warp sizing temporarily binds the loose filaments together, the condition not becoming apparent until the goods are desized and finished. Comparatively few such broken filaments protruding from the face of a satin construction, in particular, may give a hairy appearance which is quite objectionable.

A number of years ago, a cellulose acetate yarn which was abraded with the intention of producing a hairy yarn was popular in certain fabric constructions. This type of yarn was considered desirable in order to reduce the luster so notoriously objectionable in dark-dyed shades, as well as to simulate in a small way the fuller hand of a spun yarn. One difficulty encountered was the problem of maintaining uniformity of abrading (which was done mechanically), and a common fault was the production of yarns having more or less abraded or broken filaments, the result being a lack of uniformity of the woven fabric in both hand and appearance.

Miscellaneous. Physical defects that occur less frequently include single coarse or fine filaments appearing spasmodically and probably resulting from partially clogged spinnerettes. At one time the presence of a mixture of fine and coarse filaments in the viscose yarns of one rayon manufacturer was almost consistent enough to be used as a means of identifying his products. If there is an excessive amount of extremely fine filaments in such a yarn, they may be revealed by easy rupture during handling of the yarn. Also, in rare instances it has been found that the very fine filaments bring about streaks, because of their tendency to absorb so little dyestuff. An unusual condition is one in which a single hole of the spinnerette that has been only temporarily clogged suddenly becomes self-cleaning and "uncorks," producing a normal filament with a small nodule or lump on the end, formed when the hole had cleared. The heavy lump of viscose will dye darker and will be detected as a speck in dyed goods, unless the fabric is dyed in very dark shades.

"Stuck," or adhering, filaments are usually due to adhesion of two or more filaments during the coagulating process in spinning. The finished yarn shows thin places or is harsh and wiry, depending on the proportion of such filaments which are stuck together. Occasionally what appears to be such a defect in the gray goods may actually be traced to temporary adhesion of the filaments, probably by the yarn finish. Subsequent scouring of the goods results in the opening up of the yarn and the elimination of what appeared originally to be a permanent defect.

Another physical fault may be traced to lack of uniformity in the shrinkage of the rayon in wetting out. Unfortunately, this is a condition which cannot be noticed until the goods are finished, unless the weaver includes determinations of shrinkage when wet as a routine control test, which is not usual.

Chemical Faults

Although it is sometimes difficult to distinguish between physical and chemical faults, since one may be contingent upon the other, there are a few simple abnormalities which may be indicated in a study of the cause of certain fabric defects.

Degraded Cellulose. This is a rather all-inclusive term for a condition which might be more accurately described by the chemist as oxycellulose or hydrocellulose. Basically, it is assumed that something gets out of control in the rayon-manufacturing plant which results in a yarn abnormally low in tensile strength, although this is sometimes discernible only when the yarn is wet. Whether it is due to an acid degradation or to a faulty bleaching or washing (in the case of viscose-process yarns) is not of great importance, except to the yarn producer. At times there is a localized tendering of the yarns—that is, weak spots only, rather than an over-all weakening. A condition of this sort has been traced to the presence of minute particles of metals, particularly copper or iron, prior to bleaching. As is known to the chemist, these metals act as catalysts during chlorine bleaching and produce an accelerated localized oxidation, with consequent tendering in those spots. The yarn may give trouble by causing excessive breakage in the weaving mill, but this will not necessarily show up as a fabric defect unless reference is made to excessive knots or broken ends or “strip-backs” in the combination of cellulose acetate type and viscose-crepe yarns. More prevalent and interesting is the appearance of lighter dyeing ends or bands, which, on subsequent testing, are found to have low strength and elongation. The degradation is detected or confirmed by chemical test, using one of several methods commonly known to the textile chemist.

Finish and Surface Deposits. Finish applied to yarns may be the source of numerous faults in dyed goods, resulting in dyeing

variations, streaks, bands, or a cracky appearance. Not so common a fault as it was in the early days of rayon is the oxidation of certain finishing oils, which led to difficulty in their removal and caused yellowing or alteration of dyestuff absorption. Even today, unless one is certain that the finish used is most resistant to oxidation, it is considered dangerous to use yarns which have been in storage for any great length of time, because of the possibility of the oxidized products' giving trouble in the later processing of the fabric. Improper finishes, too, have been known to give difficulties in warp sizing—for example, poor adhesion of the sizing on cellulose acetate yarn warps and subsequent shuttle marks where the shuttle has bruised certain inadequately protected warp threads. It should *not* be taken for granted, however, that all such shuttle marks are due to faulty finish on cellulose acetate yarns. There are too many instances in which the weaver has the opportunity to do a poor slashing job on such warps without looking for any trouble with the yarn itself. So-called "static streaks" or "cracks" in the filling of cellulose acetate yarn fabrics have sometimes been traced to improper finish on the yarn, since the natural low moisture absorption of these fibers makes them more susceptible to the accumulation of static-electricity charges unless this is guarded against by adequate and proper antistatic lubricants.

Another chemical fault is the presence of whitish, dull "sulphur spots" on viscose yarns, which are usually removable by the processing of the fabric in ammonium sulphide solution.

Still another abnormal condition which, in one case, was traced by the yarn producer to excessive metal contamination in the water used was the formation of insoluble salt deposits on the yarn. These spots resisted all attempts at removal and appeared as white streaks in the finished fabric, rejecting the dyestuff in the contaminated sections.

Dyeing Characteristics. This is perhaps the most comprehensive term which might be applied to a great many troubles encountered in finished goods. When all else fails, it is easy for the weaver, the dyer, or the converter to attribute his woes to "bad-dyeing" rayon. It is true that, with all the controls observed in manufacturing rayon and other man-made fibers, any number of conditions may result in uneven dyeing. At the same time,

the one characteristic which receives particular attention from the yarn producer is the uniformity of dyeing of his product. All manufacturers, large or small, carry out routine tests for control of the "dye index," but it is remarkable that the finished fabrics do not show even more lack of uniformity than they do.

The fact remains, however, that not infrequently the cause of dye streaks or filling bands can be definitely traced to uneven dyeing properties in the original yarn. The difficulty lies, too often, in the inability of even the most skilled chemist or rayon technologist to find the exact cause of such differences. In other words, all physical tests, cross-section studies, and chemical tests may reveal no specific ailment; yet some warp ends and filling bobbins will exhibit differences in dyestuff absorption, sometimes very slight and even passable in plain shades, and at other times decidedly objectionable and not likely to be concealed even in well-covered printed patterns. Usually it is impossible to remedy such a defect, once the fabric is woven; but under certain conditions it is practical, through such techniques as caustic treatment, bleaching, or the careful selection of dyestuffs, to turn out a perfectly merchandisable lot of goods.

The selection of dyestuffs is perhaps the most promising remedy, but unfortunately it is still true that the art of dyeing and dyestuff manufacture has not yet reached such a stage of development that it is possible to correct all these dyeing faults in the original yarn. Very often, those colors which are best suited for level dyeing of viscose-process yarns are least satisfactory from the point of view of colorfastness to light or to washing. In one specific case, a certain blue dyestuff was very effective in eliminating filling shade bands when the samples were redyed in the laboratory. However, although the shade was exactly the same as that required by the customer, and although washfastness and lightfastness were equally good, it was not practical, because it did not lend itself to discharge printing, which was used on this particular fabric. Thus the problem resolves itself into the end use of the product, which controls the selection or calls for a compromise. For example, if the fabric is to be used by the dress trade where washability is of no interest, it may be possible to select bright shades of certain colors which are excellent in level-dyeing properties but

notoriously poor in resistance to washing. By the same token, it sometimes becomes necessary to sacrifice the more evenly dyed appearance of a fabric because the dyestuffs must be selected to give the maximum degree of washfastness for use in washable shirtings.

A laboratory technique which may be employed to trace differences to actual nonuniform dye absorption of the yarn rather than to other causes is the extraction of the dyestuff and colorimetric measurements of the extract. In the use of cellulose acetate yarns, a similar technique is based on dissolving equal weights of the shaded yarns in acetone and making a direct colorimetric comparison.

Rayon Staple

Most of the defects referred to, up to this point, have been confined to continuous-filament yarns. Some specific conditions, such as dyeing differences or extreme variations in filament size, are applicable to cut fiber as well. Others are unique and appear in staple only.

Adhesion of Filaments. One of the most common faults—generally revealed only when the goods are dyed—is that known as “splinters.” Actually, these are coarse filaments, usually produced by adhesion of the fibers to one another in the spinning process, before they are completely hardened. Naturally, the coarse fibers are comparatively harsh to the touch and closely resemble wood splinters. Even more objectionable is their propensity for dyeing darker than do the normal fibers with which they are intermingled; consequently, they show up as dark specks in light or medium-dyed shades.

Uneven Staple Lengths. Another fault which has been observed at times during the analysis of rayon staple is a lack of uniformity of staple length. In most instances, this has been traced to faulty operation of the cutter, the lengths being in exact multiples of the specified cut, apparently because of one blade's not functioning properly. Although low tensile strength and the presence of a very high percentage of fibers much longer than the specified length would not normally be noticeable, as such, in finished fabrics, these are faulty characteristics which may result in a poor-looking piece of cloth, because the weak

yarns may be traced to weak fibers and the woven goods will contain too many knots caused by the ends' breaking in spinning and weaving. The unduly long fibers are generally broken in processing and are largely responsible for the formation of uneven or neppy yarns.

Finish. Still another frequent cause for complaint has been traced to the finish on the rayon staple. Improper finish may be indirectly responsible for unevenly spun yarns, on account of difficulties likely to be encountered in opening, drafting, and spinning.

Moisture Content. The moisture content of rayon staple is something which must be carefully controlled at all times, to avoid subsequent troubles in fiber processing, yarn spinning, and fabric dyeing and finishing. In the case of viscose rayon, in particular, the amount and rate of moisture absorption is comparatively high. Since viscose-rayon fiber loses a large amount of its original dry tensile strength as the moisture content increases, there is danger of abnormal breakage in later processing, especially since the exposure of rayon with high moisture content for "conditioning" does not result in the reduction to the same level as when it is brought up from a lower moisture regain, or the "dry" side. Another danger which may be encountered is that of uneven blending if various staples with varying moisture contents are used, since the weight relationship naturally changes as the moisture content is altered. What may have started out as a 50-50 blend of viscose and acetate or viscose and wool may end up as a 55-45 blend, owing to the moisture equilibrium's being established after the original lots of fiber were weighed and introduced into the blender or the feeder. Also, varying amounts of moisture in different lots of fiber entering into continuous processing may result in uneven drafting, uneven stretching of the yarns, and uneven dyestuff-absorption rates.

The presentation of actual case histories describing typical fabric faults and photomicrographs of the defective yarn in or removed from the cloth serves to set forth more graphically the slight departures from the normal which may lead to justifiable large claims.

CASE 2-1. WARP STREAKS

Fabric

Pigment-taffeta dress goods

Construction

Count: 92×68

Warp: 100/60 dull viscose rayon

Filling: 150/90 dull viscose rayon

Finish

Plain dyed light blue

Defect

Single, continuous, dark warp streaks

Analysis

The dark streaks were confined to single warp yarns in which the denier and the twist were found to be normal. The filament counts, however, were subnormal, varying in the individual ends from 19 to 45, instead of the standard 60. It was evident, therefore, that more than one cone of the original yarn was involved. The fewer filaments are proportionately coarser and dye darker than the normal-sized filaments. This defect is usually due to clogged holes in the rayon spinnerettes through which the viscose solution is extruded in the spinning process. The defective yarns provide less cover than do the normal yarns, and in extreme cases the defect may be seen in the gray goods, presenting a "cracky" appearance. If similar low-filament yarns are woven in the filling, they will show up in the dyed goods as dark filling bands.

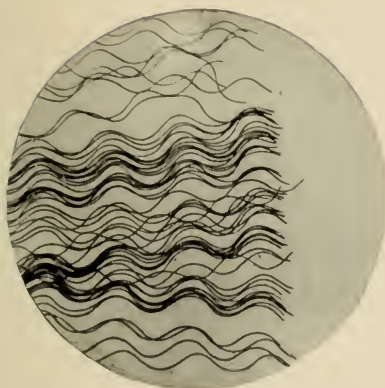


FIG. 57a. Normal, 60 filaments.



FIG. 57b. Defective, 19 filaments.

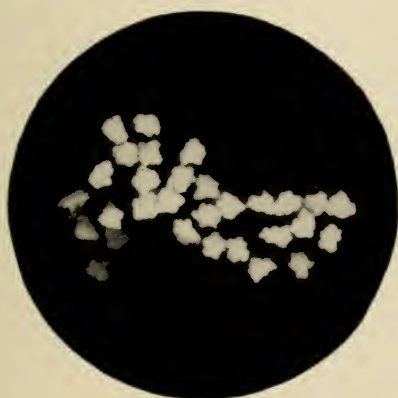


FIG. 57c. Normal, 30 filaments (cross section).



FIG. 57d. Defective, 11 filaments (cross section).

CASE 2-2. FILLING STREAKS

Fabric

Taffeta dress goods

Construction

Count: 174×64

Warp: 75/20 bright acetate rayon

Filling: 150/40 bright acetate rayon

Finish

Plain dyed rose

Defect

Irregular cracks in filling, producing streaky effect

Analysis

Analysis showed that the uneven appearance of the filling was due to irregular laying in of the filling yarn, which resulted in a cracky or "raised-pick" effect. No physical or chemical differences were detected in the yarn to account for this condition, but it was finally concluded that the defect was caused by excessive static charges' being built up during weaving. This fault is commonly referred to as "static cracks" and, although it may be produced by weaving at too low a relative humidity, it is generally attributed to the finish on the yarn's not being of a type adequate to reduce the static charge so as to permit good weaving.

CASE 2-3. FILLING BANDS

Fabric

Sharkskin-type dress goods

Construction

Count: 120×52

Warp: 150/40 dull acetate rayon

Filling: 300/80 dull acetate rayon

Finish

Plain dyed blue

Defect

Filling shade bands, starting and ending at shuttle changes

Analysis

Physical tests on yarns taken from both light- and dark-dyeing portions of the filling disclosed no significant differences. By dissolving equal weights of the light- and dark-dyed yarns in identical volumes of acetone and comparing color intensity in standard Nessler tubes, it was found that there was an appreciable difference in the amount of dyestuff absorbed by the yarns coming from different filling bobbins. As deniers and filament counts identified these yarns as being from the same producer, and as there was no indication of any gray-goods operation which could cause this difference in dyeing, it was concluded that the yarn itself was at fault.

CASE 2-4. WARP STREAKS

Fabric

Lining twill

Construction

Count: 112×68

Warp: 150/40 bright viscose rayon

Filling: Same as warp

Finish

Plain dyed tan

Defect

Short intermittent bright warp streaks distributed throughout a number of pieces

Analysis

Microscopic examination of the cross sections of a number of the short bright places showed them to contain mostly flat or elongated-type filaments. The same warp yarns examined in areas in which there were no streaks showed comparatively uniform rounded-type cross sections. Since it is impossible for the weaving mill or the finisher to produce such an alteration in the contour of the filaments through any known processing operation, this was attributed to a rayon-yarn manufacturing fault.

Although no attempt was made to advise the yarn producer of the probable cause of this imperfection, it appeared that the irregularity was introduced during the yarn-spinning operation.

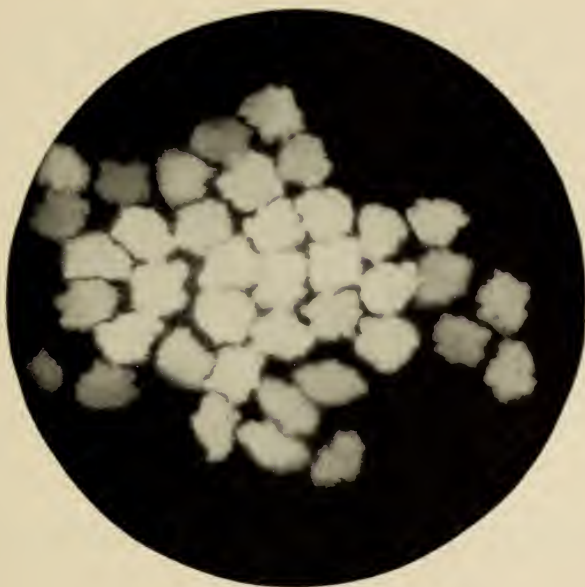


FIG. 58a. Cross section, normal portion.

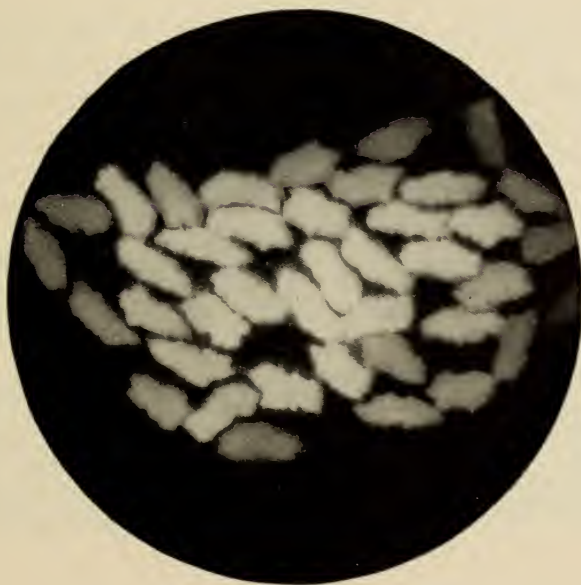


FIG. 58b. Cross section, defective portion.

CASE 2-5. "THIN" PLACES IN FILLING

Fabric

Taffeta dress goods

Construction

Count: 96×48

Warp: 150/40 bright viscose rayon

Filling: Same as warp

Finish

Navy-ground print

Defect

"Thin" places in the filling at frequent intervals throughout the piece

Analysis

Microscopic examination of those sections of the filling yarn which appeared "thin" showed that the narrowing or thinning of the yarns was due to one or two filaments' being wrapped around the remainder of the yarn in spiral fashion. As a result, that part of the filling thread (from $\frac{1}{2}$ inch to several inches in length, in this particular sample) was tightly bound by the "wrapped" filament or filaments. Since the mill used this yarn just as it was received from the producer, this fault was obviously introduced by the rayon manufacturer.



FIG. 59. Single wrapped filament.

CASE 2-6. FILLING BARRÉ

Fabric

Taffeta dress goods

Construction

Count: 180×60

Warp: 75/20 bright acetate rayon

Filling: 150/40 bright acetate rayon

Finish

Plain dyed green

Defect

Several bands of filling barré, starting and stopping at shuttle changes

Analysis

Laboratory stripping and redyeing of a cutting from the portion containing the defect yielded no improvement. In fact, the condition was detected in the stripped cutting before the redyeing. Microscopic examination of the cross sections of the filling yarns in the dark- and light-appearing sections showed significant differences in the size of the filaments, although the filament count was normal (40) in both. Denier determinations were made on short lengths of the yarns, and it was found that in the dark places the denier averaged 165, whereas in the light-dyed sections the denier averaged only 132. The repeat of the high and low deniers was at fairly regular intervals, producing a pattern effect in the woven goods. This defect was attributed to so-called "periodic denier," a variation in yarn size produced by faulty spinning during the process of yarn manufacture, probably caused by a pulsating delivery of the acetate solution to the spinnerettes.

CASE 2-7. DARK SPECKS

Fabric

Combination-yarn crepe

Construction

Count: 52×44

Warp: 100/40 viscose-rayon crepe ply-twisted with 150/40
dull acetate rayon

Filling: Same as warp

Finish

Plain dyed light blue

Defect

Dark specks

Analysis

Microscopic analysis showed that the dark-dyed specks were actually comparatively coarse single filaments protruding from, but still making up part of, the continuous-filament viscose-crepe yarns. Only the extreme free ends of these filaments were coarse and dark, the remainder tapering off to normal size and shade. This defect, which would not be noticeable in white or dark-dyed goods, was attributed to faulty rayon manufacture, resulting from a clogged hole in a spinnerette suddenly clearing or "uncorking," with a coarse gob of viscose forming on the tip end. The clogging of rayon spinnerettes is a serious problem to the yarn manufacturer. Poorly filtered viscose solution may be one source of clogging; but the chemical composition of the spinning bath may also be a critical factor. Numerous patents have been issued on techniques and formulas to prevent holes from filling up and producing excessively fine filaments or sub-normal filament counts.



FIG. 60a. Dark speck.



FIG. 60b. Single coarse filament.

CASE 2-8. WARP STREAKS

Fabric

Flat-crepe dress goods

Construction

Count: 114 \times 70

Warp: 100/60 dull viscose rayon

Filling: 100/60 viscose-rayon crepe, 2 S and 2 Z

Finish

Blue-ground print

Defect

Light-dyed warp streaks running continuously throughout piece

Analysis

Single-strand breaking-strength and elongation tests showed that the light-dyeing ends were weaker than the darker-dyeing ends and had a lower elongation at the break. The differences in wet elongations were even more pronounced. Chemical tests revealed definite evidence of degradation of the cellulose in the lighter ends. Since there was no way in which the gray mill could have produced this chemical degradation, it was evident that this was a rayon-yarn manufacturing fault.

It should be noted that stripping and redyeing, although impractical on printed goods, did not serve to eliminate the streaky warp condition.

CASE 2-9. WARP STREAKS

Fabric

Taffeta dress goods

Construction

Count: 112×52

Warp: 150/40 bright acetate rayon

Filling: Same as warp

Finish

Plain dyed blue

Defect

Continuous warp streaks, giving a "strained-yarn" appearance

Analysis

There was no evidence of mixed yarns or variation in denier, twist, filament count, or yarn cross sections. Single-strand breaking-strength and elongation tests made on a large number of warp ends removed from the fabric showed appreciable differences in the load-elongation characteristics of the yarns, although the total breaking strength and elongation were very much the same. By chance, a series of spot checks made on the yarns as they were received, before warping, by the mill showed a similar condition and this confirmed the fact that the variation was not due to any fault of the weaving mill. Apparently the warp ends having this variation in elongation, when they were subjected to the same load during warping or slashing, developed differences in strains which showed up as a streaky or tight-end condition in the finished fabric.

CASE 2-10. "CHALKY" FILLING

Fabric

Alpaca-type dress goods

Construction

Count: 68×52

Warp: 50/1 combed cotton

Filling: 150/40 bright viscose rayon

Finish

Plain dyed brown

Defect

Short "chalky" or dull spots in the filling

Analysis

Microscopic examination revealed that the short "chalky" spots were actually minute sections in which the filling yarn had been highly twisted, with the result of less light reflection than was given by the normally twisted sections. As the weaving mill was using the yarn as received from the producer without adding twist, it was concluded that these unevenly twisted places were introduced in the manufacture of the rayon.

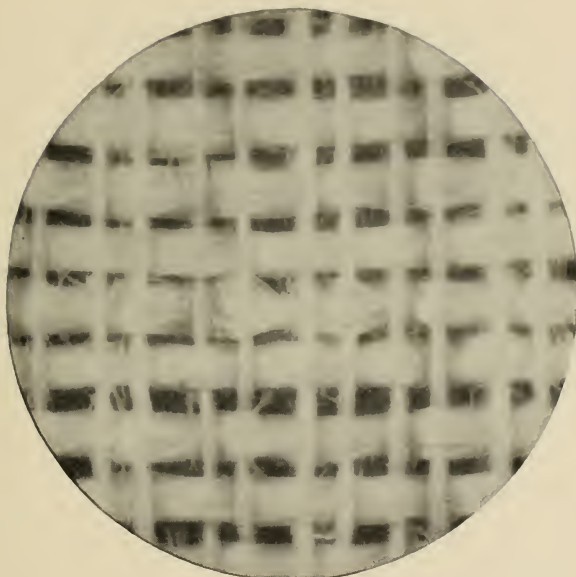


FIG. 61a. "Chalky" spot.



FIG. 61b. Twisting kink.

CASE 2-11. BRIGHT SPECKS

Fabric

Spun-rayon and wool-blend dress goods

Construction

Count: 38×36

Warp: 14/1 60% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon
25% $1\frac{1}{2}$ -in. $5\frac{1}{2}$ -den. bright viscose rayon
15% 58's wool cut $1\frac{1}{2}$ in.

Filling: Same as warp

Finish

Plain dyed navy

Defect

Bright specks throughout, giving a tinsellike sparkle effect

Analysis

Microscopic examination showed that this defect was due to several of the $5\frac{1}{2}$ -denier fibers having abnormal, flat-filament formation. The sparkle effect was caused by these comparatively large flat surfaces reflecting more light than the normal portions of the fibers. In cross section, the normal, rounded filaments had normal contours, while the flat portions were elongated. This defect was apparently produced by some faulty coagulation process during the spinning of the staple.

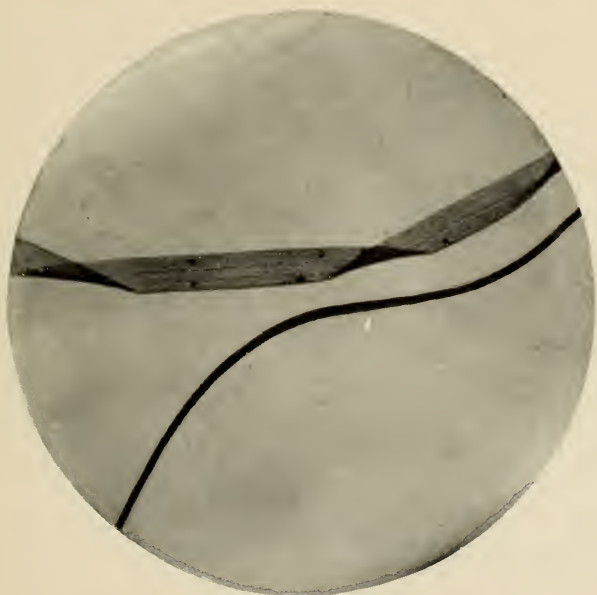


FIG. 62a. Abnormal flat filament and normal round filament.

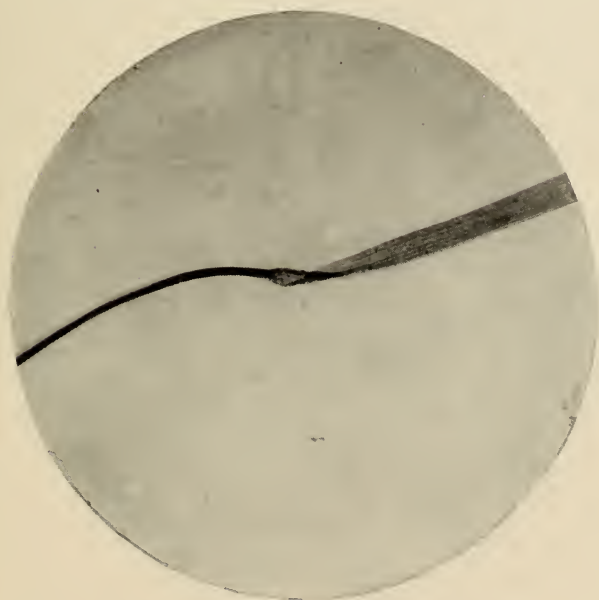


FIG. 62b. Flat portion in normal filament.

CASE 2-12. WARP STREAKS

Fabric

Dress-goods crepe

Construction

Count: 160×68

Warp: 75/20 bright acetate rayon

Filling: 100/40 viscose-rayon crepe, 2 S and 2 Z

Finish

Plain dyed dark blue

Defect

Single warp streaks throughout the piece

Analysis

Tests of denier, filament count, single-end breaking strength and elongation, and twist revealed no difference to account for the warp streaks. Microscopic examination of the yarn cross sections showed significant variation between the normal and the light-appearing warp ends, to indicate some fault in the yarn itself. The light, streaky ends all had a preponderance of filaments with two lobes, whereas the remaining normal yarns had three or four lobes. Although no effort was made to determine whether the net effect was one of luster or of dyeing differences, it seemed reasonable to conclude that there was a basic fault in the manufacture of the acetate rayon which produced this defect.

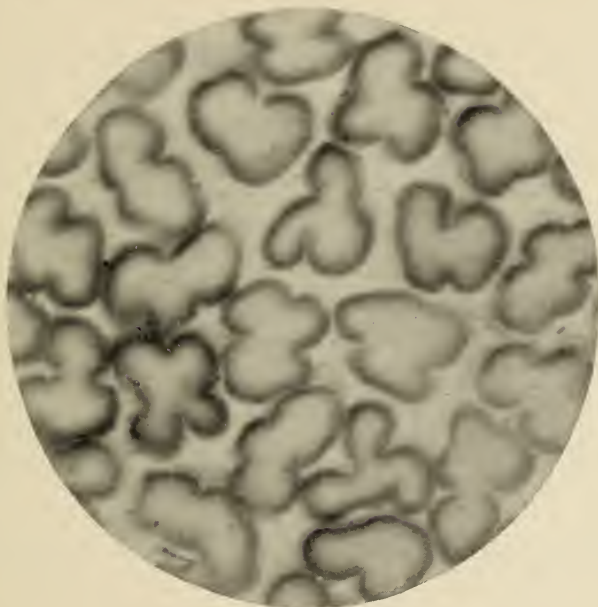


FIG. 63a. Cross section of normal end.

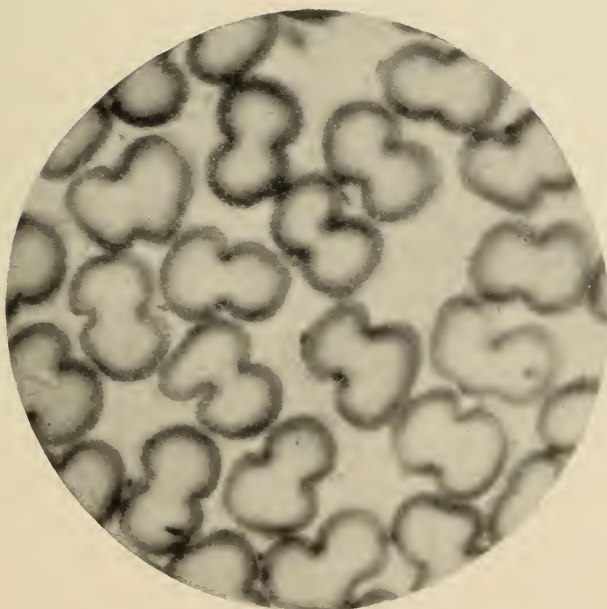


FIG. 63b. Cross section of defective end.

CASE 2-13. WARP STREAKS

Fabric

Panne satin dress goods

Construction

Count: 225×76

Warp: 100/26 bright acetate rayon

Filling: 100/40 dull acetate rayon

Finish

Plain dyed white

Defect

Continuous warp streaks

Analysis

Analysis showed no physical or chemical differences between the streaky and the normal-appearing warp ends. The difference was apparently one of luster, as the condition was visible in goods finished white. Laboratory boil-off of a cutting of gray goods obtained from the mill showed the presence of the same defect. From a knowledge of the properties of some of the finish which was being used by the yarn manufacturer, it was suspected that the defect was due to the presence of some lots of yarn in this warp with differences in age, the finish on some ends affecting the luster. This suspicion was confirmed when information obtained from the weaving mill disclosed the fact that, in one warp, several cases of very old yarn had been used, along with newly delivered yarn of the same type. The yarn manufacturer assumed all responsibility, because the mill had not been cautioned about any danger in using old and new yarn together.

CASE 2-14. WARP STREAKS

Fabric

Pigment-taffeta dress goods

Construction

Count: 72×56

Warp: 100/60 dull viscose rayon

Filling: 150/90 dull viscose rayon

Finish

Plain dyed white

Defect

Grayish-appearing single warp streaks

Analysis

The grayish-colored ends were found to be normal in twist, denier, filament count, cross section, and tensile strength and elongation. Microscopic examination showed no evidence of any foreign matter deposited on the surface of these ends. Laboratory scouring in soap and soda-ash solution resulted in no improvement; but when the sample was subjected to a mild chlorine bleach, the streaky condition disappeared. This defect was probably due to the presence of a few ends of incompletely bleached rayon, a yarn-manufacturing fault.

In this case it was possible to correct the condition in the finishing plant before delivering the goods, although it entailed a slight surcharge for the extra processing.

CASE 2-15. "FOREIGN MATTER"

Fabric

Spun-rayon dress goods

Construction

Count: 64×38

Warp: $30/1$ $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: $15/1$ $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Finish

Plain dyed rose

Defect

Dark specks, described by the examiner as "foreign matter," in warp and filling

Analysis

Microscopic examination showed the "foreign matter" to be composed of hard bunches of rayon staple dyed darker than the normal fiber. This defect, frequently described as "splinters," is produced in the manufacture of the fiber and is caused by the adhesion of several filaments during the spinning operation, forming larger, coarser filament bunches, which characteristically dye darker.

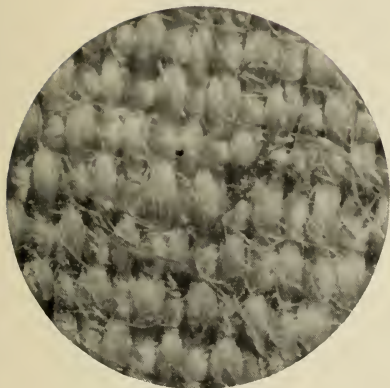


FIG. 64a. Dark speck on fabric surface.

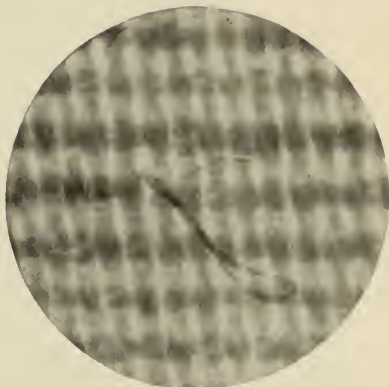


FIG. 64b. Speck seen by transmitted light.



FIGS. 64c and d. "Splinters" of coarse fibers.

CASE 2-16. FILLING STREAKS

Fabric

Taffeta dress goods

Construction

Count: 68×44

Warp: 150/112 cuprammonium rayon

Filling: Same as warp

Finish

Plain dyed blue

Defect

Short filling streaks, giving a cracky appearance

Analysis

Microscopic examination showed that a large number of the filaments in the filling yarns in the streaky areas appeared to be bound together. It was impossible to pry them apart with a pick needle, and a thorough soap and soda-ash scour in the laboratory failed to open them up to a normal, full yarn. Further microscopic study of the cross sections in those portions of the filling confirmed the fact that a number of the filaments were actually bonded together. In some instances they gave the appearance of single filaments two or three times the normal diameter, with practically no line of demarcation between the several smaller filaments which had been "fused" together. This fault was attributed to some defect in the manufacturing of the yarn which allowed adhesion to take place before the filaments were completely hardened.

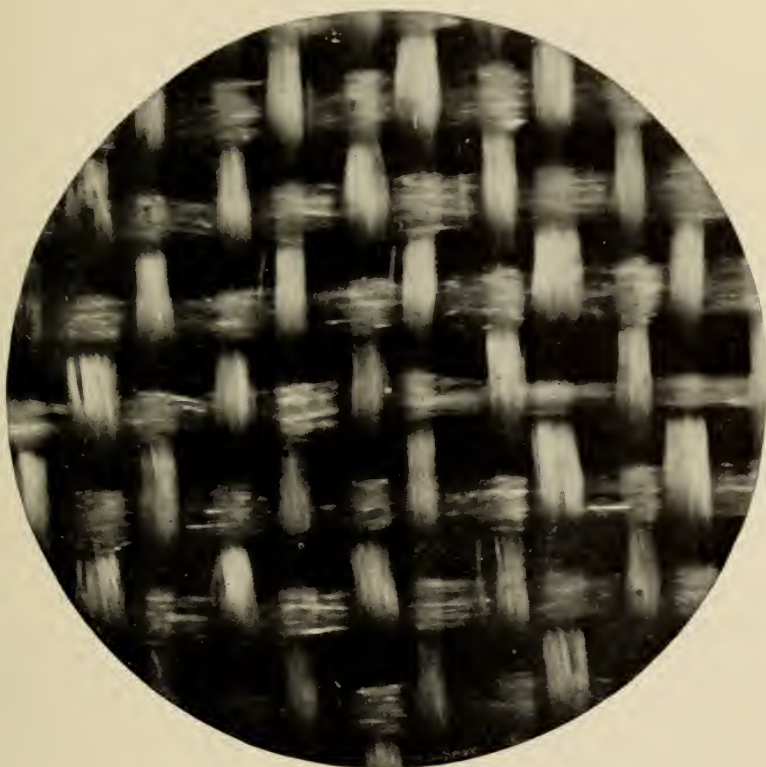


FIG. 65a. Streak due to adhering filaments.



FIG. 65b. Thin section in yarn.

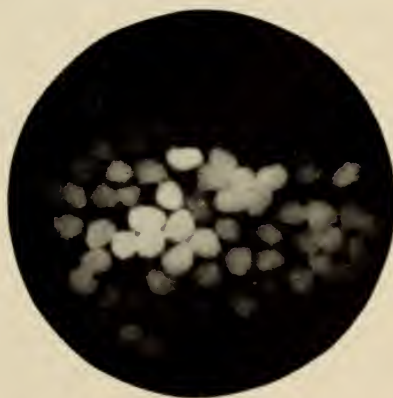


FIG. 65c. Yarn cross section showing "fused" filaments.

CASE 2-17. FILLING BANDS

Fabric

Sharkskin-type dress goods

Construction

Count: 100×72

Warp: 150/40 dull acetate rayon

Filling: Same as warp

Finish

Plain dyed white

Defect

Filling bands running from shuttle change to shuttle change

Analysis

Laboratory scouring and bleaching did not eliminate the bands, and boil-off of a cutting of gray goods showing a similar condition resulted in no improvement. Deniers, filament counts, and twists were the same in both light- and dark-appearing sections of the filling and there was no evidence of any abnormal breaking strength or elongation of the yarn. Microscopic examination of yarn cross sections showed the filament contour to be uniform, but the yarn in the light-appearing bands seemed to contain more pigment than that in the darker sections. This was confirmed by examination of a longitudinal section and by chemical analysis. The difference in pigment content resulted in a luster differential which could not be eliminated in dyeing or finishing. Comparison with standard dull-luster yarn of the same manufacturer indicated that the yarn with the lesser amount of pigment was normal production. It was concluded that the bobbins of more highly pigmented yarn represented some abnormal manufacturing condition.



FIG. 66a. Normal pigment in filament.

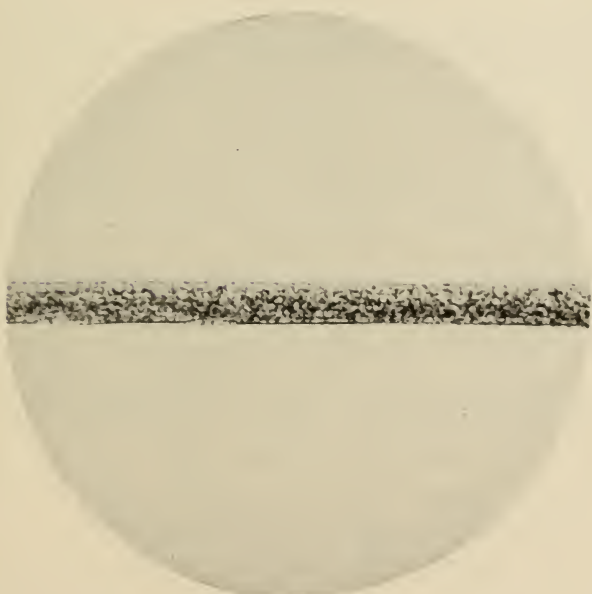


FIG. 66b. Abnormally high pigment content.

CASE 2-18. FUZZ BALLS

Fabric

Pigment-taffeta dress goods

Construction

Count: 104×72

Warp: 100/60 dull viscose

Filling: 150/90 dull viscose

Finish

Plain dyed maize

Defect

Small bunches or balls of fiber gave the cloth a "neppy" appearance.

Analysis

Examination showed that this defect was due to the presence of what is commonly known as "fuzz balls." These are nothing more than a few broken filaments in the warp yarns which have "balled up" in the reed or drop-wires on the loom and, in this case, had managed to get by into the cloth. Usually this chafing and balling up of some filaments will result in a break in that warp end, especially if the chafing is very severe. Microscopic examination revealed the fact that the rayon filaments comprising these fuzz balls were much finer in size than those of the normal yarns. Under the circumstances, it was reported as a yarn fault, since the filaments in any one yarn are usually fairly uniform in diameter. Where these particular ends contained a few extra-fine filaments, they were naturally more subject to damage in processing and weaving, and the weaver did not feel responsible for this abnormal condition.

Attention is called to the fact that similar fuzz balls are *not* due to faulty yarn but may be traced to abnormal chafing during weaving.

CASE 2-19. RESIST STREAKS

Fabric

Satin underwear fabric

Construction

Count: 250×104

Warp: 55/20 bright acetate rayon

Filling: 75/30/35 bright viscose rayon

Finish

Plain dyed navy

Defect

Short sections of the viscose-rayon filling resisted dyeing.

Analysis

It was impossible to eliminate the resist spots on the rayon yarn by any means which would not be harmful to the acetate. Although chemical tests were not made to try to identify the material responsible for the dye resist, it was eventually ascertained that the mill had purchased this yarn with the understanding that it was of inferior quality and could be used for white or light shades only. The yarn manufacturer had knowledge of this defect, which he attributed to insoluble salt deposits. The converter to whom the gray goods had been sold, however, ignored the mill's classification of "for white only" and had attempted to dye a number of pieces in dark shades at his own risk. Under the circumstances, neither the weaver nor the yarn supplier would assume any responsibility for this defect.

CASE 2-20. FILLING STREAKS

Fabric

Pigment-taffeta dress goods

Construction

Count: 92×68

Warp: 100/60 dull viscose rayon

Filling: 150/90 dull viscose rayon

Finish

Plain dyed dark blue

Defect

Short, light, fillingwise "flashes" throughout

Analysis

Laboratory tests showed that the light-appearing "flashes" resisted wetting out, as if they had a protective water-resistant coating in those sections. By stripping with sodium hydro-sulphite solution and then redyeing, the short streaks were completely eliminated. Under the circumstances, since the finisher had already used a boil-off and scouring procedure which had been adequate to remove the warp sizing completely, it was concluded that this defect was due to the presence of sections of the original filling yarn containing finish which was abnormally difficult to remove. The fault was, therefore, classified as one for which the rayon producer was responsible.

The elimination of certain imperfections by laboratory stripping and redyeing does not always indicate any fault on the part of the dyer, but is helpful in determining whether or not some condition can be so corrected to make the goods salable.

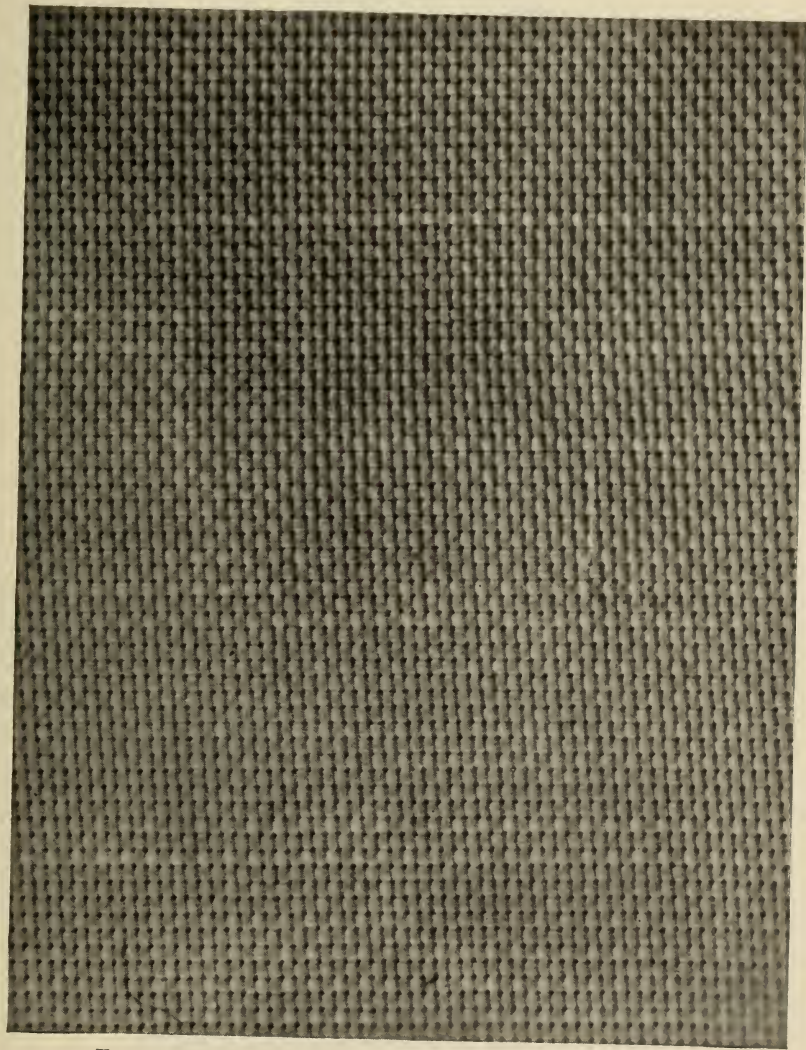


FIG. 67. Streaks due to unremoved finish on filling yarn.

CASE 2-21. FILLING BANDS

Fabric

Lining twill

Construction

Count: 112×68

Warp: 150/40 bright viscose rayon

Filling: Same as warp

Finish

Plain dyed gray

Defect

Filling shade bands throughout full pieces of goods

Analysis

Deniers and filament counts of yarns taken from both the light-dyed and dark-dyed bands were normal—in this case, 150 denier, 40 filaments. Microscopic examination of the rayon cross sections showed a decided difference between the contours of the filaments in the light-dyeing sections as compared with those in the normal dark-dyed portions. Since the mill had proof of the fact that at the time these goods were woven there was only one make of 150-denier, 40-filament, bright-luster, viscose-process rayon in the mill, it was reasonable to assume that the fault was one which originated in the rayon producer's plant. This might have been caused by the mixing of two lots having different cross sections and different dyeing properties, or, more likely, through the inadvertent production of a small poundage of yarn having faulty cross-section and dyestuff affinity. Examination of representative samples from part cones of the same shipment, as well as of earlier lots from the same producer, indicated that the yarns with the flat filaments were not normal.

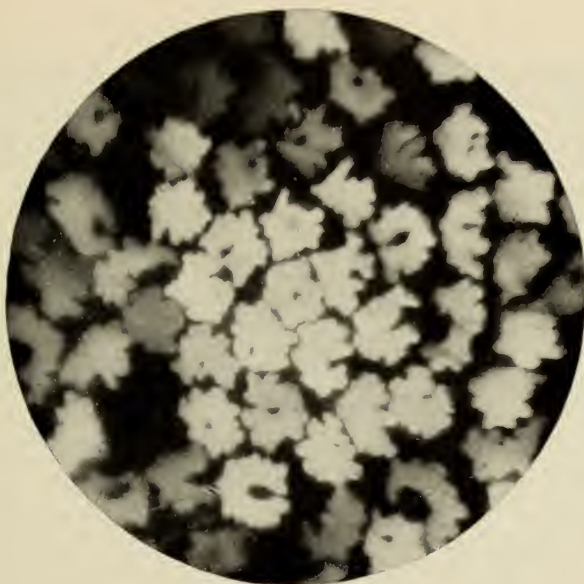


FIG. 68a. Cross section of normal yarn.

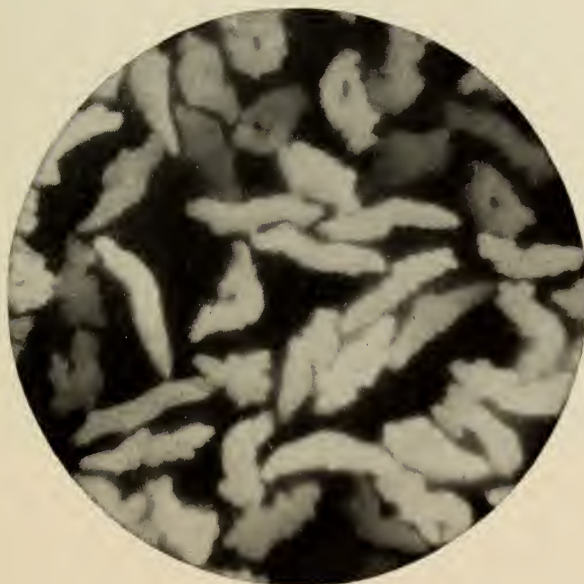


FIG. 68b. Cross section of defective yarn.

CASE 2-22. WARP STREAK

Fabric

Flat-crepe dress goods

Construction

Count: 114×64

Warp: 100/60 dull viscose rayon

Filling: 100/40 bright viscose-rayon crepe, 2 S and 2 Z

Finish

White polka-dot print on blue ground

Defect

Single, dark warp streak

Analysis

Analysis showed this defect to be due to a mixed warp end. The darker dyeing yarn was 100/40 bright viscose, instead of 100/60 dull as specified. Inasmuch as the weaver's supply of the 100/40 bright yarn was in the form of skeins only, and as the warp was prepared from cones, it would not have been possible for him to introduce such a mixture. It was, therefore, assumed that the yarn manufacturer was at fault in having placed a single cone of the wrong yarn in a case of the 60-filament warp yarn.

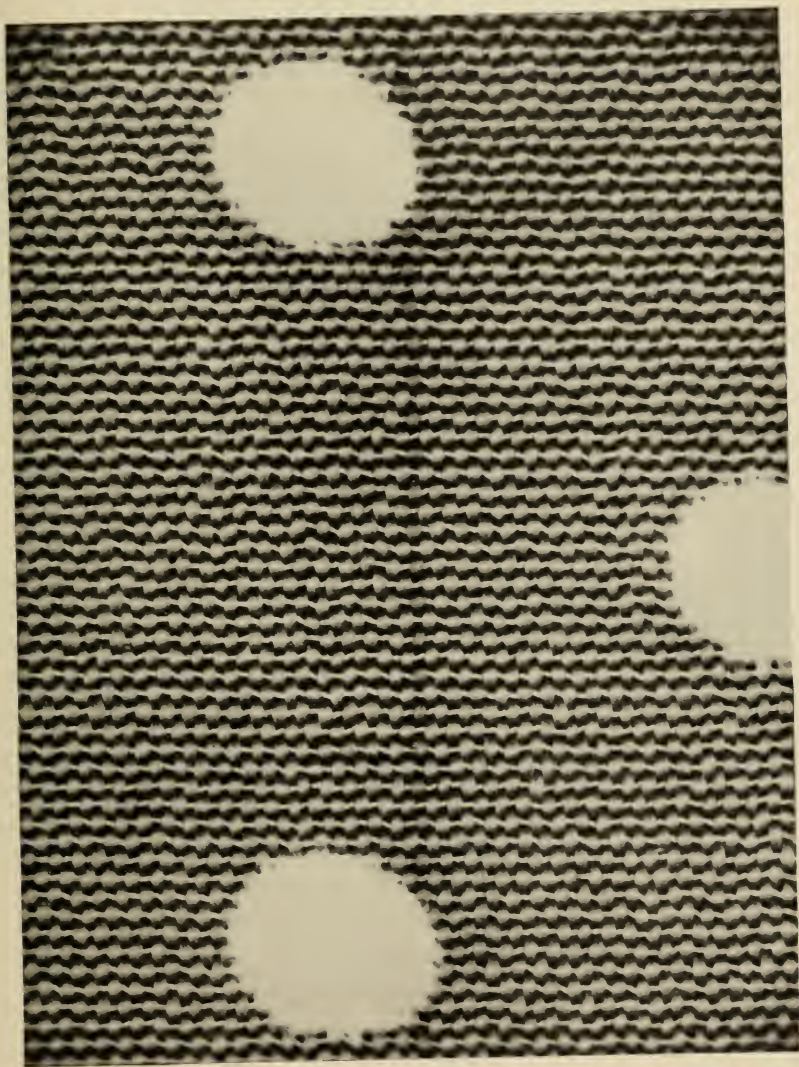


FIG. 69. Dark end due to mixed rayon.

CASE 2-23. TENDER FILLING

Fabric

Twill dress goods

Construction

Count: 148 \times 80

Warp: 100/100 dull viscose rayon

Filling: 150/90 dull viscose rayon

Finish

Plain dyed light blue

Defect

Filling found to be tender in several sections of the piece

Analysis

Tensile-strength tests made on the fabric in two places of the cutting submitted showed the filling to be decidedly weaker than normal. Examination of the yarn in those short sections disclosed the fact that it sized only about 60 denier and the filaments were stuck together and the rayon was very brittle. This was attributed to a rayon yarn defect, apparently produced through some fault in the spinning operation. It would have been impossible for the weaving mill or the dyer to have caused any such deterioration or change in the rayon yarn.

CASE 2-24. PATTERNING IN FILLING

Fabric

Rayon-taffeta dress goods

Construction

Count: 110×48

Warp: 150/40 bright viscose rayon

Filling: Same as warp

Finish

Plain dyed green

Defect

Pattern effect in the filling

Analysis

Single-end tensile-strength and elongation tests made on a series of continuous lengths of filling yarn in normal and "patterning" areas showed slight differences in total elongation at the point of rupture. Wetting out the sample resulted in a puckering in the filling direction, which indicated the overstretching of portions of the yarn. Careful measurements of the stretched sections showed a definite pattern at a frequency which could be traced to the size and build of the package on which the original yarn was delivered to the mill. This afforded definite proof that the overstretching had taken place in the preparation of this package by the yarn producer, rather than by any mis-handling in the weaving mill.

CASE 2-25. CREASES

Fabric

Satin automobile slip-cover fabric

Construction

Count: 240×72

Warp: 150/40 bright viscose rayon

Filling: 210/34 bright nylon

Finish

Cross-dyed navy (viscose) and white (nylon)

Defect

Short warpwise creases

Analysis

Examination showed that the short creases started at filling changes, where the yarn seemed to have contracted more than normally for a few inches, giving a stretched- or tight-yarn appearance. Physical tests on the yarn from the "tight" and normal areas confirmed the fact that the nylon varied in its stress-strain characteristics. This defect was attributed to the presence of some yarn which had not been so completely shrunk, or "relaxed," as that in other sections. At the time these goods were woven, it was difficult for the yarn manufacturer to produce all nylon which was completely and uniformly relaxed, and the strained-yarn appearance was frequently encountered in both warp and filling of woven fabrics.

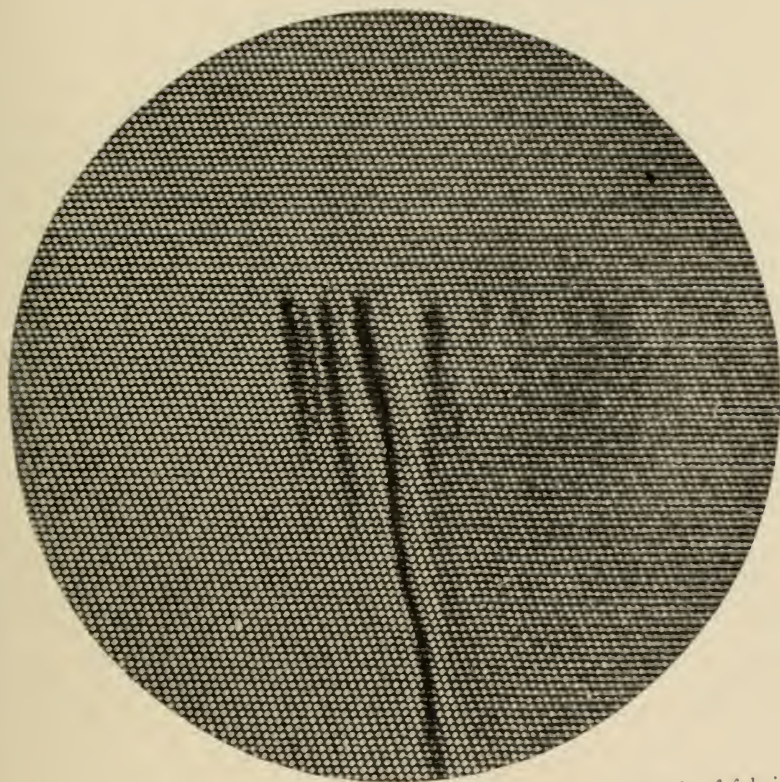


FIG. 70. Creases due to variation in filling-yarn shrinkage (back of fabric).

CASE 2-26. FILLING STREAKS

Fabric

Pigment-taffeta shirting

Construction

Count: 92×68

Warp: 100/60 dull viscose rayon

Filling: 150/100 dull viscose rayon

Finish

Gray goods

Defect

Examination of the gray goods at the mill showed the presence of numerous short filling streaks.

Analysis

Microscopic examination revealed that the short filling streaks were due to places where the yarn had much higher twist than the normal. Twist determinations showed that, in some of these streaky sections, the twist was as high as 17 turns per inch, instead of the standard 7 turns. This defect was due to faulty rayon yarn.



FIG. 71. Abnormally high filling-yarn twist.

CASE 2-27. WARP STREAK

Fabric

Nylon underwear fabric

Construction

Count: 248×110

Warp: 2 ends of 30/10 semidull nylon plied 14 turns S

Filling: 70/34 semidull nylon

Finish

Plain dyed tea rose

Defect

Single warp streak

Analysis

Analysis revealed that this defect was due to the presence of an end of nylon yarn in the warp which had the correct number of filaments, but sized 105 denier instead of 30. Breaking-strength and elongation tests showed it to be "undrawn" nylon. In the manufacture of nylon, the finished yarn is obtained by drawing down the extruded filaments by a stretching process. Occasionally, some undrawn yardage remains in the package. While normally these undrawn portions are eliminated before the finished package is delivered to the mill, in this case it was obviously not detected during inspection.

CASE 2-28. WARP STREAKS

Fabric

Taffeta dress goods

Construction

Count: 112×52

Warp: 150/60 bright viscose rayon

Filling: Same as warp

Finish

Plain dyed green

Defect

Over-all warp streaks

Analysis

Independent of any tendency for the warp yarn itself to dye unevenly, or any fault of the dyer in not obtaining a more level dyeing, a certain amount of this streaky, or "reedy," appearance may have been due to the manner in which the filaments of the individual warp yarns adhered to each other and lay in the cloth. Some viscose-rayon yarns have been found to be more circular in contour than others, presenting a somewhat rounded yarn with uniform covering power. Other yarns, though the filaments are of the same appearance and contour, tend to lie in the fabric in ribbonlike formation. Although it is sometimes possible for the weaving mill to alter the "roundness" of single-warp ends through tension, twisting, slashing, or other means, it is generally thought that this is an inherent characteristic of certain viscose yarns, probably originating with the rayon-spinning operation.

CHAPTER 3

DYEING AND FINISHING FAULTS

In discussing faults which can be attributed to the dyer and finisher, it is necessary first to have a general conception of some of the major operations to which goods are subjected after they are received by the finisher for wet processing. While no attempt will be made to give a full description of the operations and practices employed in modern dyehouses, printworks, and finishing plants, the following will serve as an outline of the most common procedures, to provide some idea of the many steps involved in converting a piece of goods from the gray to the finished state, and to help toward a better understanding of the case histories described later.

Cotton Goods

Gray cotton goods may or may not be singed over gas or hot-plate singers, to remove the fiber fuzz from the surface of one or both sides, after which they are usually desized, either by use of an acid or, more commonly, by an enzyme. The latter, usually preferred to the acid method of desizing because of the danger of acid tendering of cellulose-base fabrics, may be one of several types. All are effective by virtue of their action in converting the starches used as warp sizing into water-soluble compounds. The goods are then "boiled off" to remove the soil and the cotton waxes, minerals, pectins, and some coloring matter, by the use of pressure kiers or in open-width, continuous boil-off equipment. In order to obtain a good white or to prepare for dyeing light shades, the natural coloring matter of the cotton is removed by a bleaching operation, in which hypochlorite solution ("chemic") or hydrogen peroxide is used.

Mercerization, by means of a strong solution of sodium hydroxide at room temperature, is carried out on gray or boiled-off

or bleached cotton goods. Under this treatment, the cotton fibers swell and untwist, luster is increased, and dyestuff absorption is improved. Under certain controlled tension conditions, it is sometimes possible to obtain a higher strength in cotton fabrics by the mercerization process.

Processing of Rayon Fabrics

Rayon fabrics, because of the comparatively clean nature of the fibers and the yarns, do not require the severe kier boiling or scouring that is very necessary on cotton goods. Some form of thorough desizing and scouring is needed, nevertheless, in the case of all fabrics in which warp sizing has been used, in order to remove all the sizing material, as well as to free the goods from dirt, from the small amounts of finish normally used on the original yarns as delivered to the weaving mills, and from the fugitive tints which are often applied by the yarn companies or the mills for identification purposes. Some spun-rayon fabrics receive a singeing treatment not unlike that for cotton goods, to remove the projecting ends of filaments and to provide a smooth-surfaced finished fabric, as distinct from the "woolly"-type hand which might be obtained if singeing were omitted.

Flat goods, such as satins, taffetas, and twills, must be handled in the open width on jigs or continuous ranges or paddlers, to avoid streaks and creases. Crepe fabrics require even more careful handling, depending on their construction and the effect desired. At times, they must be embossed by specially engraved steel rollers, to prevent unevenness of the "pebble" or creping action during boil-off. Certain other constructions may require "skein" or "stick" boil-off, the fabric being suspended by strings in the selvage in hank form. Fabrics of all nylon or Orlon are generally given "presetting" treatments by boiling water, passage over a series of specially designed heat-setting rollers or through enclosed high-pressure steam chambers. Fabrics of the rayon pigment-taffeta type usually receive a caustic soda pretreatment, to swell the fibers and yarns and provide a fuller hand and appearance, as well as to improve the levelness of dyeing of some viscose rayons.

It is impossible to list all the special "tricks of the trade" employed to obtain certain finished results, most of which are logical operations based on specific facts or scientific data, but some of which are based on almost fantastic whims of practical dyers. Unusual and novelty constructions frequently require considerable experimenting on the part of even the most skilled dyer to obtain certain desired characteristics of hand or appearance.

As a guide to finishing faults, the following outline lists some of the principal causes of defects, classified as originating from mechanical damage, chemical damage, and damage through faulty processing operations.

Mechanical Damage

1. Excessive tensioning or stretching of goods, either warp-wise or fillingwise, is not an uncommon finishing fault. As a result of such overstretching, the finished goods may be tender, light in weight, thin in hand, poor in appearance, or—if excessively wide—impractical to cut along with other, normal-width materials.

2. Too high a shrinkage in warp or filling will result in the fabric's being altered in appearance, bulky, or overweight, too narrow for proper cutting; or it may show too low a return in finished yardage from the gray.

3. Chafe or rub marks produced by contact with some projecting or rough machine part or through similar abnormal physical contact may result in a permanent distortion or damage to the fibers. At times, this abuse will show up as darker dyeing spots or streaks if the damage took place before dyeing, lighter places if the bruising took place after dyeing, or merely as areas with different light reflection if the surface fibers or yarns have been distorted or flattened out without actual rupture.

4. Creases may be introduced through faulty handling of the gray goods before processing, or by improper dyeing procedure, or while the goods are being put up after they have been completely finished.

5. Punctured holes or tears may be the result of careless handling or may be made by foreign materials or protruding ob-

jects in boil-off or dyeing vessels. Rayon fabrics, in particular, are likely to be damaged when they are wet, because, it must be remembered, they have only about one-half of their normal dry strength in the case of viscose or about two-thirds of the original strength in the case of cellulose acetate yarns.

6. Embossing or Schreiner calender cuts are encountered most in rayon fabrics.

7. Tenter-frame clip marks may leave permanent damage, especially in the case of delicate fabrics.

8. Moire, or water-impression, marks are likely to show up on plain woven or faille-type rayon fabrics which are batched up in open width while still wet.

9. Excessive napping of cotton goods can produce tender spots, especially in those areas of lightweight fabrics in which the yarns may be slightly finer than normal.

10. Inadequate presetting of certain nylon or Orlon goods may result in lack of stability in the finished fabrics, leaving them with a tendency to show excessive contraction or, even, expansion when they are in storage or in actual use.

Chemical Damage

1. Overbleaching is often the cause of the tendering of cotton goods in a bleachery and may be due to lack of control of chemical-bath temperatures, concentrations, incomplete removal of bleaching agents prior to drying, or bleaching in the presence of metals which act as catalysts in accelerating the oxidation process. Rayon fabrics, too, are highly susceptible to damage in bleaching if proper precautions are not observed.

2. Yellowish or brown kier stains are found in bleached cotton goods when there is faulty working of the kier in boil-off, poor circulation, or filtering of some of the cotton impurities through the "channeling" of the liquor.

3. Dyestuff stains may be seen on cotton or rayon fabrics, appearing through the deposition of some undissolved color, or by contamination from particles of dry dyestuff floating in the air of the dyehouse. White or light-shade goods, in particular, are obviously readily susceptible to picking up tiny color specks through contact with any piece of equipment in a dye-

house, unless every precaution is taken to keep such equipment thoroughly clean.

4. Unintentional saponification of acetate-rayon yarns and subsequent uneven dyeing or tendering may be the outcome of too highly alkaline a boil-off or of accidental causticizing treatment.

5. Alkali damage to wool may take place when the alkali content of the preparatory bath is high and temperatures are elevated.

6. Mineral acids will be likely to cause damage to cellulosic fibers if they are employed in too-high concentrations or at too-high temperatures or for too prolonged a time in any processing operation.

7. Overdrying has been known to produce permanent harshness in textile materials, as it is generally impossible to restore the normal softness of natural or synthetic fibers by subsequent addition of moisture. Dyestuff absorption may also be affected by such overdrying.

8. Many chemicals produce permanent stains or resist spots in all types of fabrics when they become accidentally spattered in the dyehouse or the finishing plant, and analysis and detection of the chemical which caused the damage is generally extremely difficult.

9. Tendering of fabrics of any fibers may be caused by the action of catalysts used in crease-resistant or shrink-proofing treatments, oxidation of sulphur to sulphuric acid in some dye-stuffs, embrittlement through surface application of certain resins, or bleaching to remove color before redyeing.

10. In rare cases, when potassium permanganate is used as an oxidizing or a bleaching agent, there is the danger of obtaining brown stains caused by the formation of oxides of manganese, which can be removed by chemical reducing agents.

11. Some finishes applied to goods may yellow with age, causing an appreciable change in color or cast of the dyed fabric. This is particularly noticeable in white or pastel shades. Other finishes of an oily nature may go rancid with age and impart a disagreeable odor.

Operational Faults

1. Desizing of gray goods may be incomplete through too-rapid processing or through failure to use a desizing agent, or because of too high a bath temperature, which destroys the effectiveness of certain enzymes. Incomplete size removal can be responsible for warp streakiness, uneven dyestuff penetration, or harsh hand of the finished goods.

2. Incomplete scouring is another source of blotchy dyed goods, unremoved tint, or poor dyestuff penetration. In the case of unremoved tints, the fault may be traced to the use of an inferior detergent or to too low a boil-off temperature. Instances have been reported in which a tint was found to be completely fugitive in a neutral soap-solution scouring bath, but nonfugitive in one of the synthetic fatty-alcohol type of detergents. In another case, in which the dyer complained of his inability to remove the tint applied to some rayon goods by the gray mill, it was found that, although the indicating thermometer on the boil-off bath registered a temperature of 180°F., the actual bath temperature was below 160°F.—a fact which would not have been detected if the dyer had not complained and a representative from the gray mill had not visited the finishing plant for a complete investigation. In still another case, it was discovered that the batching up of goods impregnated with certain enzymes for warp-sizing removal in the presence of common salt served to set some tints and render them non-fugitive.

3. Poor dyestuff penetration is sometimes the cause of a blotchy- or streaky-appearing piece of finished goods.

4. Careless selection of dyestuffs, or of a combination of colors to obtain a certain shade, particularly on rayons, may bring about uneven dyestuff exhaustion from the bath, with the result that the more open yarns, such as nubby types, will absorb more of one color than of another and take on a specky appearance. Considerable research work has been carried out to determine the behavior and exhaustion rate of all direct dyestuffs; and the data, which are readily available to all dyers, should be of great assistance in the avoidance of such troubles.

Proper selection of dyestuffs is also important for obtaining the most level dyeing effects on many viscose-type rayons. Here, again, the dyestuff manufacturers have been of material assistance in providing the conscientious dyer with information that may prevent faults resulting from improper choice of dyestuff.

5. Too-rapid cooling of hot-dyed goods is frequently responsible for a cracky or open appearance in dyed rayon goods.

6. Poor color matching between two or more fibers in spun, blended fabrics will result in a two-tone dyeing effect, which often accentuates any slight normal irregularities in the evenness of the spun yarns.

7. In the case of sulphur-dyed dark shades, a bronzy appearance may be traced to the use of an excessive amount of salt during the dyeing.

8. Carelessness in operation may be entirely responsible when prints of more than one color are out of fit or register.

9. Scratches on engraved print rollers or small nicks in doctor blades will yield streaks in printed fabrics, owing to color or discharge paste's being introduced unintentionally.

10. Inadequate soaping after dyeing or printing will sometimes result in poor colorfastness in the finished dyed or printed fabric.

11. Improper diazotizing and developing of this class of dyestuff will be responsible for stains or blotches in the dyed goods.

12. If the boil-off of rayon-crepe gray goods is carried out at too high a temperature or too rapidly, the goods may show poor, uneven creping or a cracky appearance.

13. Shading from selvage to center is a fault sometimes observed in jig-dyed goods. It is generally attributed to too-rapid cooling off of the selvages during dyeing.

14. End-to-end shading is often encountered in plain dyed goods and is caused by exhaustion of the color from the dye bath or by some other irregularity of the jig dyeing or pad dyeing of fabrics.

15. Incomplete curing of resin finishes can result in the resin's showing abnormally high losses in subsequent washing.

16. Poor penetration of resin finishes is frequently the cause of harsh surface deposits and the tendering of rayon or cotton fabrics to which it has been applied. A similar effect is some-

times attributed to migration of the soluble resin to the surface of the fabric, if the drying conditions are such that one face of the cloth is subjected to excessively high temperatures.

17. Creases introduced before the application or curing of resin finishes will be permanently set in the goods and will be impossible to remove unless the resin is eliminated by chemical means.

18. Uneven mercerization of cotton goods is the cause of streakiness when such goods are subsequently dyed, because of the different rates of dyestuff absorption.

19. Uneven piece lengths of rayon fabrics dyed together in the same dye box will come out different in shade, because one piece has remained in the dye bath longer than the other during the dyeing cycle.

20. The heat setting of nylon fabrics in the gray has been known to make an otherwise fugitive tint more or less indelible and comparatively difficult to remove in the following boil-off operations.

Holes in Finished Goods

The appearance of holes in finished goods, ranging in size from tiny pinhead-sized openings in tightly woven constructions to openings as large as an inch or two in diameter, presents one of the most perplexing problems in the life of a "trouble shooter." As one technician once stated, "there is 'nothing' to analyze." Nevertheless, given experience, patience, and a knowledge of all the processes through which the defective specimen passed, it is sometimes amazingly simple to find the solution.

If possible, the first step is to determine the frequency and general distribution of the holes, because very often the pattern or repeat of the damage, or even the lack of such a pattern, will provide a worth-while clue. A regular repeat pattern might be traced to some mechanical damage on a machine, or a slightly diminishing or increasing distance between the holes, indicating what is almost a repeat, would show evidence that damage had taken place while the fabric was in roll form, the repeat being a measure of the roll circumference.

In the case of very small holes or cuts, careful inspection should be made to try to determine whether only one set of yarns is damaged, or whether the damage has been done predominantly to one set of yarns—that is, the warp or the filling. At times, a close examination will reveal sharp edges at some portion of the hole, indicating a cutting action rather than a tear. Also, the fibers on the edge may show some signs of discoloration, as from chemical damage, or lack of color where there has been poor dyestuff penetration. In the case of the latter, this would be reasonably positive proof that the damage had taken place after the dyeing operation; for if the ragged edges had been exposed to dye, they would have been well penetrated and might even appear darker in shade than the remainder of the sample under investigation.

Although it is impossible to weave a fabric with a hole, except in the novelty constructions, there are numerous conditions which may be responsible for the production of one or more holes when the goods are wet-processed by the dyer. To cite a few, the holes may be caused by knots' being insecure and slipping open; by thin places in either warp or filling spun yarns that give way when the goods are under tension, either warpwise or fillingwise (particularly in the case of rayons, which are much weaker when wet); by insect damage; or by chemical damage. Or they may originate with tiny cuts introduced by too rough a sand roll or by the goods' passing through the shear. The last-mentioned damage may be the result of careless operation or adjustment of the shearing blades, or it may be due to contact because of folded or doubled-over selvages or creases in the gray goods.

In the dyeing and finishing plant, holes may be the result of puncturing by a rough or jagged wood or metal material in one of the processing machines; of cuts made by faulty or improperly applied embossing rolls; of chemical damage; of singeing; or of slubs, bunches, or hanging threads accidentally pulled out.

But, as is the case in all other types of defects, there are often holes which appear mysteriously in finished goods and which defy all the skill of the analyst as well as the gray-mill man

and the dyer, and which compel us to report: "Holes, cause unknown."

Close Cooperation between Dyer and Gray Mill Essential

Whenever it is possible, close cooperation between the weaver and the dyer and finisher can be very helpful in minimizing defects which appear in finished goods and in reducing subsequent claims to an absolute minimum. As is evident from the foregoing list of many common faults, if the finisher is advised of size content, fiber blends, and other factors which the gray mill should not consider confidential, he will be in a position to render the best possible finished result on the fabric with a minimum of difficulty. It is obviously to the gray mill's advantage to be promptly advised if certain imperfections are noticed by the dyer before too much damage has been done or before too many pieces of gray goods have been woven. By the same token, any finisher will be grateful for information or advice on composition of warp-sizing materials or fabric construction which will enable him to proceed most rapidly and efficiently, without the need of making chemical analyses and laboratory tests of his own to supply information which the gray mill already possesses. During recent years, such close and intelligent cooperation between the weaver and the dyer has been the rule rather than the exception, and both have gained the respect of their customer, the converter, by working together to furnish the best possible finished product with a minimum of lost time or extra cost.

CASE 3-1. DIFFERENCE IN LUSTER

Fabric

Cotton-and-rayon dobby broadcloth

Construction

Count: 100×64

Warp: 40/1 combed cotton with stripes of 150/40 bright viscose rayon

Filling: 40/1 combed cotton

Finish

Plain white

Defect

The goods delivered to customer appeared to be duller than the original sample submitted.

Analysis

Although from preliminary examination it seemed that a dull or semidull rayon had been used in the warp, instead of a bright-luster rayon, analysis showed the construction to be identical with that of the original sample. Further examination, however, revealed the presence of a starch finish on the goods which had been rejected by the customer. Laboratory scouring and removal of this finish restored the bright, lustrous appearance which was desired. The starch finish, which had apparently coated the bright rayon sufficiently to make it dull, was readily removed from the entire lot in a refinishing operation.

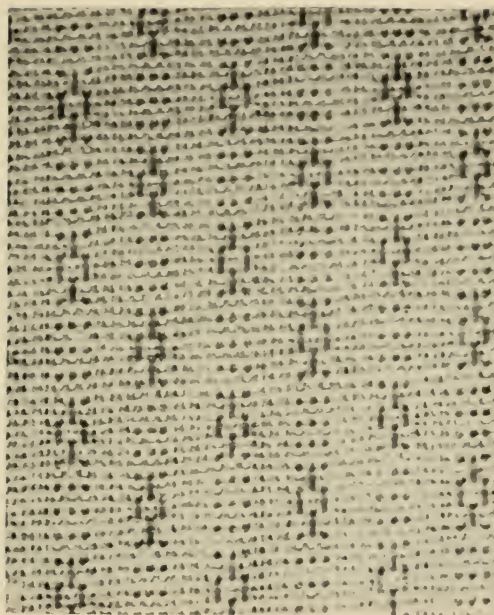


Fig. 72a. Normal finish.

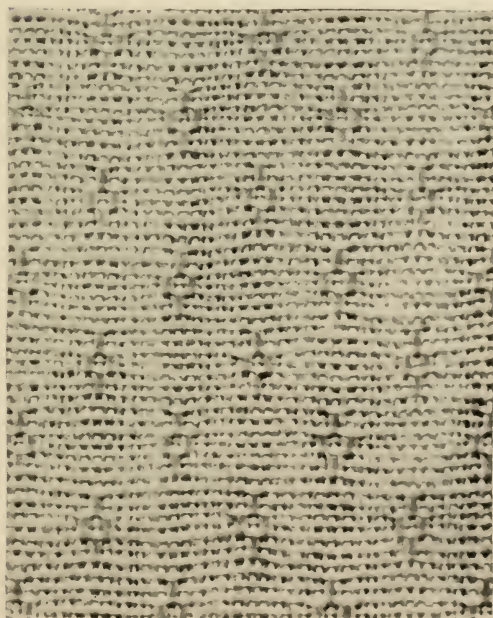


Fig. 72b. Luster dulled by starch finish.

CASE 3-2. BLUE SPECKS

Fabric

Cotton broadcloth shirting

Construction

Count: 144×76

Warp: 80/2 combed cotton

Filling: Same as warp

Finish

Plain white

Defect

Small blue specks and short blue streaks throughout

Analysis

Under the microscope, it was evident that the blue specks were color stains, rather than foreign deposits on the fabric. Under chemical tests, the spots reacted like a dyestuff or a pigment. The short streaks had the shape and appearance of small bits of yarn, but close examination showed them to be blue stains also. Under ultraviolet light, it was found that not only did the visible specks and streaks fluoresce in a bright orange color, but scores of additional smaller specks became visible. Since a similar fluorescence was obtained with an indanthrene violet, used as a bluing agent by the dyer, it was concluded that the defect was due to poor dispersion of this pigment in the finishing operation. There was no evidence of the gray goods' containing any such dyestuff or pigment when they were delivered to the finisher. The streaks which resembled threads were probably made by bits of lint in the finishing bath which picked up excessive color and left imprints, or mark-offs, on the fabric.

CASE 3-3. SHADE VARIATION

Fabric

Spun-rayon poplin dress goods

Construction

Count: 104×44

Warp: 30/1 $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: 15/1 $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Finish

Plain dyed navy

Defect

Shade variation in pieces said to have been dyed together

Analysis

Inspection showed that some of the pieces were redder in cast than others with which they were supposedly dyed in the same lot. Analysis of the thread count, yarn size, twist, and fiber content indicated that samples of two of the pieces which were different in shade were identical in construction and composition. Laboratory stripping with sodium hydrosulphite and redyeing in the same bath resulted in both cuttings' coming up to the same shade. The dyer insisted that the pieces had been dyed together and was unwilling to accept the laboratory's findings, claiming that in the gray goods there was some difference of fiber content and that the hydrosulphite used in stripping the color presumably had a leveling effect on the dyeing. Further laboratory investigation was carried out and it was discovered that, when the original dyed goods were immersed in chlorine bleach ("chemic"), one sample came down to a reddish shade, whereas the other became a dirty tan color. It was obvious that the components of the dyestuff in the two pieces were not identical, and the dyer was at fault.

CASE 3-4. HOLES

Fabric

Novelty dress goods

Construction

Count: 90×64

Warp: One end of 100/60 viscose rayon, alternating with one end of 100/40 bright acetate rayon

Filling: 30/1 $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Finish

Cross-dyed red (viscose) and white (acetate)

Defect

Small holes throughout

Analysis

Inspection under a low-power pick glass showed that the holes were due to breaks in the white acetate warp yarns. There was also evidence of a slight fusing or dissolving of the tips of the broken ends. Although the original construction specified the use of *bright* acetate warp yarn, microscopic examination revealed that these yarns were not pigmented but were dulled through the use of some chemical agent. It was subsequently determined that, prior to dyeing the goods, the finisher had used a phenolic compound as a delusterant. Through lack of proper control of chemical concentration and temperature, the acetate was not only delustered but was also partly dissolved in those areas where the holes appeared.

The delustering of bright acetate rayon by the finisher is seldom practiced in this country today.

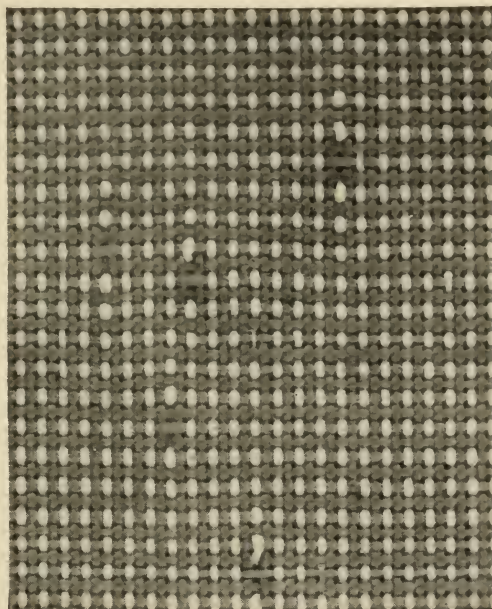


FIG. 73a. Breaks in white warp yarn.



FIG. 73b. Single, partly dissolved acetate end.

CASE 3-5. FILLING BANDS

Fabric

All-spun-rayon poplin dress goods

Construction

Count: 64×60

Warp: 20/1 $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: 14/1 $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. dull viscose rayon

Finish

Plain dyed gold

Defect

Dark filling bands of varying intensity

Analysis

Chemical tests showed evidence of appreciable amounts of warp sizing in the dyed goods, as well as several partially unremoved colored "Day and Night" shift-stamp marks. The bands were eliminated by laboratory stripping in sodium hydrosulphite solution and redyeing. Inspection of the gray goods showed the presence of similar sections of filling yarn which had evidently been tinted to a slightly heavier depth of shade than other portions of the filling. The defect did not appear in pieces of the same gray-goods style which were dyed in medium and dark shades, and it was concluded that unremoved tint from some portions of the filling were showing through under the gold color. Since laboratory desizing and scouring trials on a cutting of gray goods proved that the warp sizing could be completely removed in normal processing, and the shift stamp mark was made with a tint that was fugitive in a mild-soap scour at 180°F. , it was evident that the finisher had not done a thorough job in preparing these goods prior to dyeing.

CASE 3-6. DIRTY-APPEARING NUBS

Fabric

Spun-rayon linen-type dress goods

Construction

Count: 48 × 48

Warp: 30/1 80% 1½-in. 1½-den. bright viscose rayon
20% viscose rayon cut to make flake yarn, plied
with 14/1 combed cotton

Filling: Same as warp

Finish

Plain dyed gold

Defect

Nubs which appeared to be dirty or darker than the fabric itself

Analysis

Examination showed that the nubs had a greenish cast, giving the appearance of being dirty in contrast with the gold background. Microscopic analysis of these nubs showed that they were no different in composition from the remainder of the rayon staple in the spun yarn. It was observed that the bobbin tails or hang threads at the selvage had a similar greenish color.

This defect was attributed to the dyer's use of a combination of dyestuffs which did not exhaust at the same rate. Apparently one of the components was a green or blue dyestuff which exhausted from the dye bath and went on to the fiber more rapidly than the yellow. Since the nubs, or open fiber tufts, are comparatively loose and absorb the color more rapidly than does the remainder of the hard-spun yarns, they took on the dirty greenish appearance which produced this defect.

CASE 3-7. FILLING BAND

Fabric

Spun-rayon-and-silk dress goods

Construction

Count: 54×44

Warp: 18/1 85% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. dull viscose rayon
15% silk noils

Filling: Same as warp

Finish

Light-blue ground with white printed stripe

Defect

Narrow filling band across the width of the piece

Analysis

On a few threads from the filling being raveled, it was found that the "band" did not follow the filling exactly. Careful examination showed that what appeared to be a band was actually a printing defect, some of the blue-dyed ground having been partially discharged in a narrow strip across the full width of the cloth. This condition was probably caused by some of the discharge printing paste carrying over on the doctor blade and coming into light contact with the blue ground.

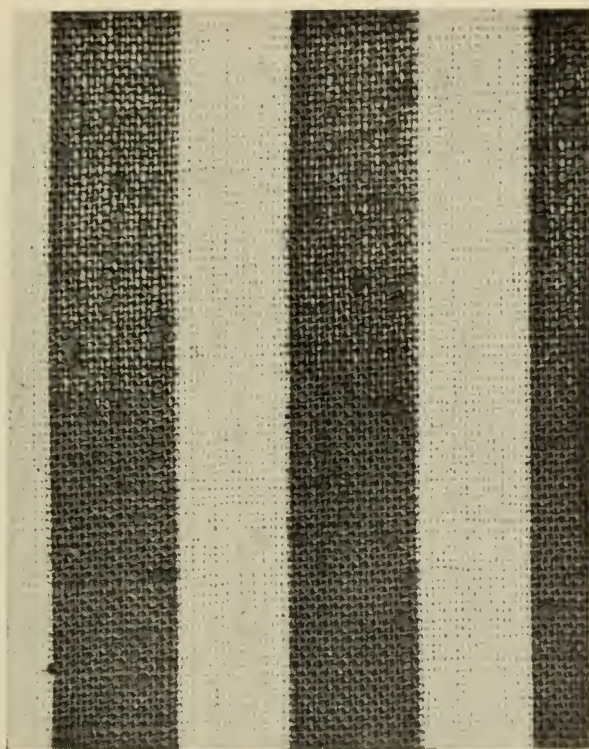


FIG. 74a. White discharge paste carried over to blue-dyed ground stripe.

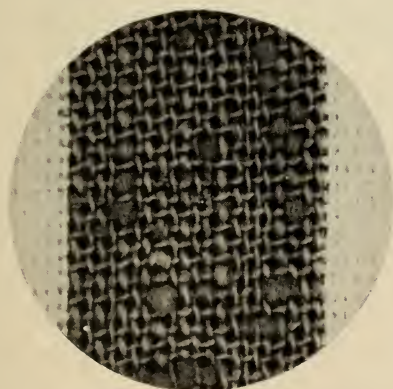


FIG. 74b. Normal area in stripe.

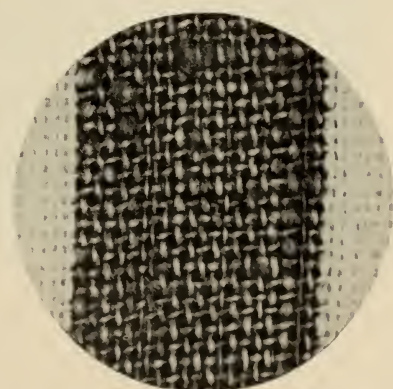


FIG. 74c. Area with partially discharged paste in stripe.

CASE 3-8. SPOTS

Fabric

Taffeta dress goods

Construction

Count: 180×56

Warp: 75/20 bright acetate rayon

Filling: 300/104 dull acetate rayon

Finish

Plain dyed light blue

Defect

Small dark spots scattered throughout the piece

Analysis

Microscopic and chemical analysis showed that the spots were due to small particles on the surface of the fabric, apparently caused by undissolved dyestuff's becoming deposited on the cloth during or after dyeing.

In order to prevent this type of defect, the dispersible dyestuff most commonly used for acetate-rayon fabrics must be prepared very carefully before being added to the dye bath.

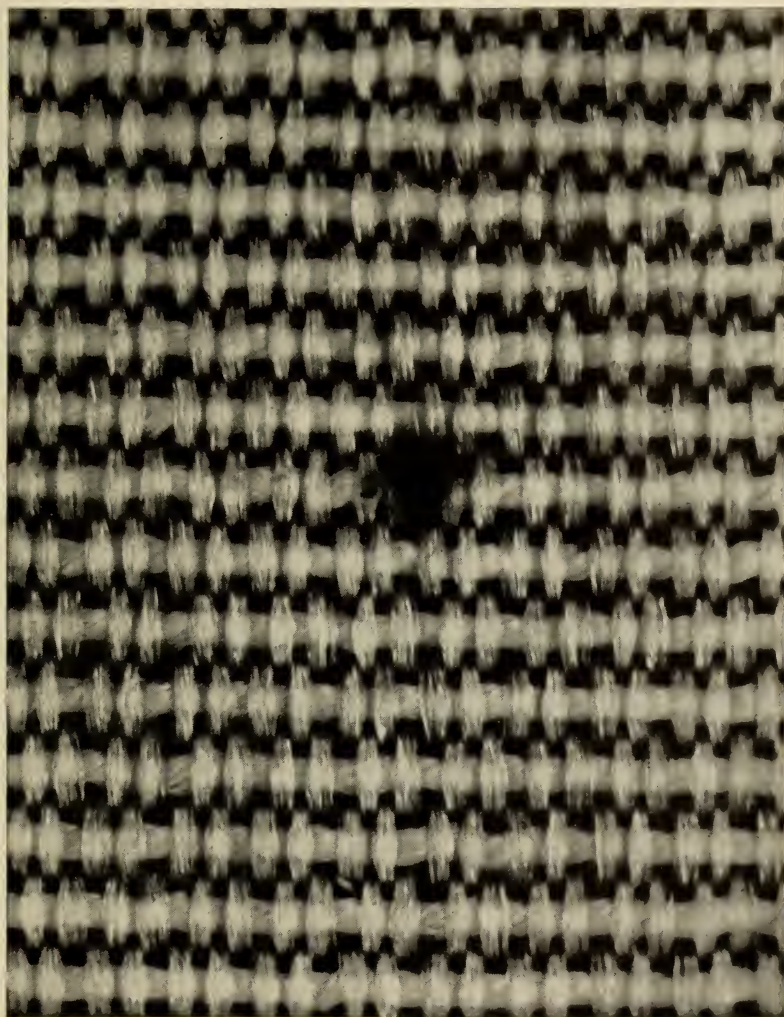


FIG. 75. Dyestuff deposit on fabric.

CASE 3-9. UNEVEN SHADE

Fabric

Spun-rayon-and-wool suiting

Construction

Count: 90×44

Warp: $30/2$ 25% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon
50% 2-in. 3-den. dull viscose rayon
25% 58's wool cut 2 in.

Filling: Same as warp

Finish

Plain dyed gray

Defect

Pieces said to have been dyed together differed in shade when finished.

Analysis

Analysis of the construction and fiber content of representative cuttings of the pieces which differed in shade showed that they were otherwise identical. Laboratory stripping and redyeing in the same bath resulted in both swatches' coming up to exactly the same shade. On checking the dyer's records, it was found that the pieces varied appreciably in length. Further investigation revealed that the shorter pieces were always lighter than the longer pieces.

It was concluded that the difference in dyeing was due entirely to the variation in the lengths of the pieces. Goods dyed in a winch or dye beck should be of approximately the same length, since in the dyeing operation where the pieces are rotated over the reel in an endless rope, the longer pieces remain in the dye bath for a longer period of time, with the result that they will usually dye appreciably darker, although they are handled in the same dye lot.

CASE 3-10. HARSH HAND

Fabric

Spun-rayon-and-wool suiting

Construction

Count: 104 × 74

Warp: 20/1 25% 1½-in. 1½-den. bright viscose rayon

50% 2-in. 3-den. dull viscose rayon

25% 58's wool cut 2 in.

Filling: 22/1, same blend as warp

Finish

Plain dyed rose with resin finish

Defect

Customer complained of the harshness of hand of several pieces, as compared with earlier deliveries.

Analysis

Preliminary examination indicated that the difference in hand was due to the finish. However, after laboratory removal of the resin from cuttings of both the original and the unsatisfactory pieces, the new goods were still harsh. It was assumed that an error had been made in using a blended yarn with a lower grade of wool, but microscopic analysis showed the quality to be identical. While the yarns were being examined microscopically, it was observed that the wool fibers in the harsher feeling goods were damaged in appearance. Chemical analysis was made and the wool content of the harsh fabric was found to be appreciably lower than the original amount specified. Tests made of the dyestuffs used confirmed the fact that the goods had been vat-dyed and it was decided that the dyer had caused the fiber's degradation through careless use of sodium hydroxide, the damaged wool giving the harsher hand.

CASE 3-11. WARP STREAKS

Fabric

Flat-crepe dress goods

Construction

Count: 135×64

Warp: 100/34 dull acetate rayon

Filling: 100/40 bright viscose rayon crepe, 2 S and 2 Z

Finish

Blue-ground print

Defect

Continuous warp streaks across the full width of the piece

Analysis

Chemical tests showed that the acetate warp yarns in the sample submitted had been partially and unevenly saponified by the dyer prior to printing. The streaks were due to uneven dyeing, the amount of color picked up varying with the degree of saponification. Laboratory dyeing tests made on representative head ends of gray goods showed that the acetate warp dyed uniformly when *acetate-type* dyestuffs were used. While saponification of acetate rayon is fairly common practice in preparing goods for discharge printing, there are many factors which may be responsible for uneven saponification, such as normal tension variations introduced during warping, slashing, and weaving, or inadequate control by the dyer. Under the circumstances, neither the yarn manufacturer nor the weaver assumes responsibility for such a defect.

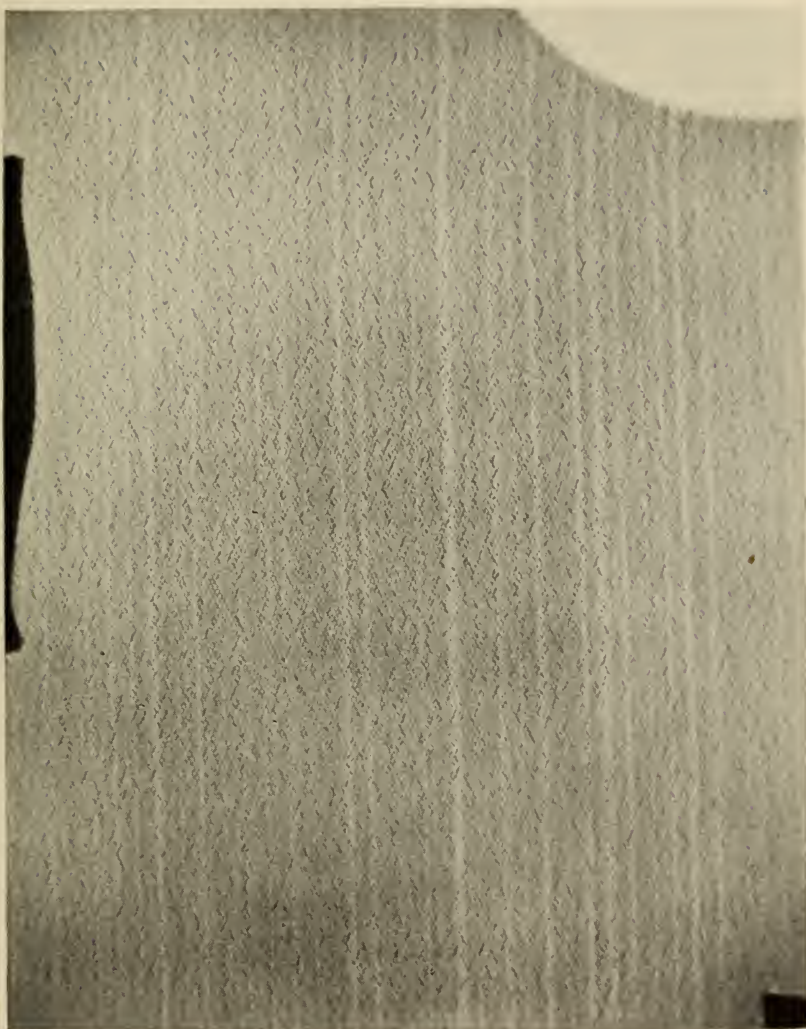


FIG. 76. Streaks due to uneven saponification of acetate.

CASE 3-12. ROUGH FACE AND SHORT STREAKS

Fabric

Satin dress goods

Construction

Count: 212×68

Warp: 100/40 bright acetate rayon

Filling: Same as warp

Finish

Plain dyed blue

Defect

Rough and uneven face, with short streaks throughout. The finisher claimed some irregularity in the weave or some other gray-goods fault.

Analysis

Microscopic examination showed that the short "streaks" did not follow the filling threads exactly, but were definite deformations of the warp threads. They were made to disappear almost completely by holding under tension, the streaks pulling out like small, hard creases. Laboratory wetting out and ironing likewise resulted in almost complete removal of the crimped places. It was concluded that this defect was probably caused by impression marks from the calender roll, producing a mechanical distortion and small crimps in the fabric.

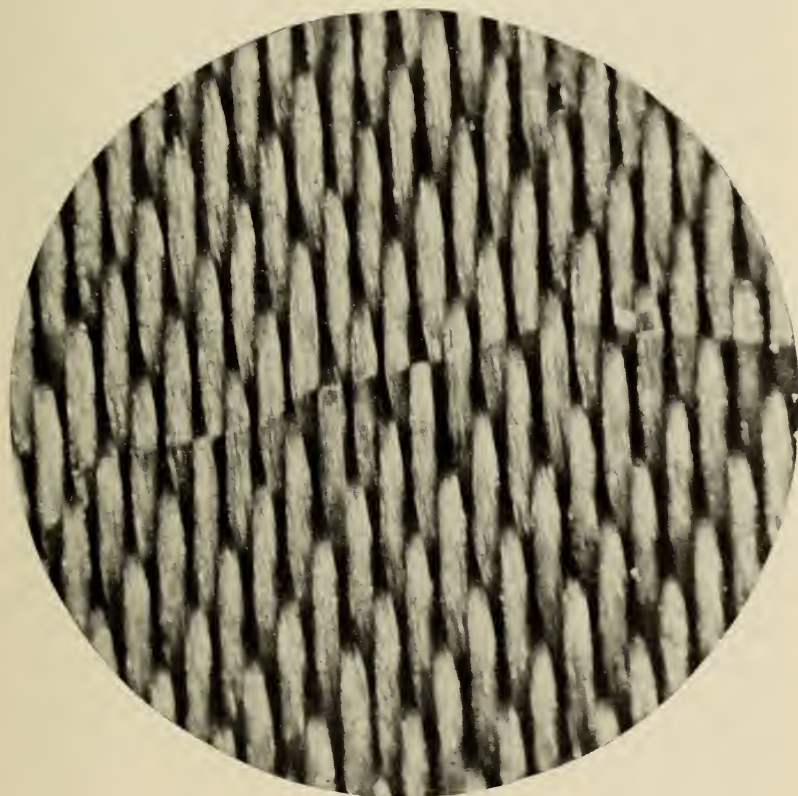


FIG. 77. Fabric distortion from calender imprint.

CASE 3-13. WHITE STAINS

Fabric

Combination-yarn dress goods

Construction

Count: 52×52

Warp: 100/40/50 bright viscose rayon, plied with 150/40 dull acetate rayon arranged 1 S and 1 Z

Filling: 150/40/20 dull acetate rayon

Finish

Plain dyed black

Defect

White stains

Analysis

Inspection of the sample submitted showed the stains to be irregular in size and shape and to be scattered throughout the piece. Microscopic examination disclosed the fact that, in the stained areas, the acetate portion of the warp combination yarns and the acetate filling yarns were partially dissolved. Since there was no possibility of the gray mill's having any chemicals in the plant which might produce such a solvent action, it was concluded that this defect was caused by some careless contamination in the finishing plant.



FIG. 78. Stains due to partial dissolving of acetate yarns.

CASE 3-14. CUTS OR HOLES

Fabric

Crepe dress goods

Construction

Count: 96×64

Warp: 150/40 dull acetate rayon

Filling: 100/40 viscose-rayon crepe, 2 S and 2 Z

Finish

Plain dyed rose

Defect

Small cuts throughout

Analysis

Examination revealed very small cuts and holes in various portions of the full piece, with no particular pattern or repeat. Since it was known that this fabric was woven on looms which were equipped with rubber-covered take-up rolls, it was considered unlikely that the damage could have occurred during weaving. It was learned from the dyer that, in keeping with the normal manner of processing this construction, the goods had been embossed prior to boil-off. The embossing acts to control irregular creping by guiding the pattern formation when the yarns contract during boil-off. In this case, it appeared that, through faulty operation of the embossing roll, or because of some defect in the engraving itself, the delicate rayon yarns had been slightly cut. In the following wet operations, the damaged and weakened yarns disintegrated, and this resulted in the appearance of numerous holes.

CASE 3-15. TENDER FABRIC

Fabric

All-cotton pongee

Construction

Count: 72×100

Warp: 70/1 combed cotton

Filling: 44/1 combed cotton

Finish

Plain dyed beige and Schreiner calendered

Defect

Goods said to be tender throughout the piece

Analysis

Fabric tensile-strength tests made on standard file head ends and portions of the piece in question confirmed the fact that tendering was in the warp direction only, strength loss being from 30 to 50%. Further investigation revealed the fact that the tendering was not uniform across the width of the goods, the warp near one selvage being appreciably weaker than either the center part or the opposite selvage. It was determined that these goods had been given a Schreiner-calender finish. This type of calender has finely engraved lines running at a slight angle with the length of the roll. The impression of these lines on the face of cotton fabrics enhances their appearance by imparting a subdued luster. Microscopic examination of the piece submitted for analysis showed that in places where the warp was tender the embossed Schreiner lines had penetrated through to the back of the cloth. It was evident, therefore, that this defect was due to uneven pressure on the Schreiner-calender roll, the finely engraved lines cutting across the warp yarns to such an extent on one side as to cause an appreciable weakening of the fabric.

CASE 3-16. WARP STREAKS

Fabric

Novelty dress goods

Construction

Count: 90×64

Warp: One end of 100/60 dull viscose rayon, alternating with one end of 100/40 dull acetate rayon

Filling: Same as warp

Finish

Cross-dyed black (viscose) and white (acetate)

Defect

Dark warp streaks

Analysis

Examination showed that the warp streaks were due to a number of the acetate warp yarns, sometimes singly and more often in groups of several adjacent ends, being slightly grayish in cast. Microscopic analysis revealed the presence of very small black particles on the yarn surface, and it was assumed that this discoloration was caused by a small amount of dyestuff adhering to certain of the acetate warp ends. The condition was corrected by treatment with a proteolytic enzyme, indicating that there had been some unremoved gelatin sizing on those warp yarns, this material being subsequently dyed by the rayon dyestuff. It was difficult to explain why certain ends had retained part of the warp sizing. This may have been due to uneven size pickup in slashing as a result of tension differences or slight variations in finish on the original yarn. Nevertheless, in view of the ease with which the residue could be removed, it was decided that the finisher was to blame for not having given the fabric a thorough boil-off and desizing, prior to dyeing.

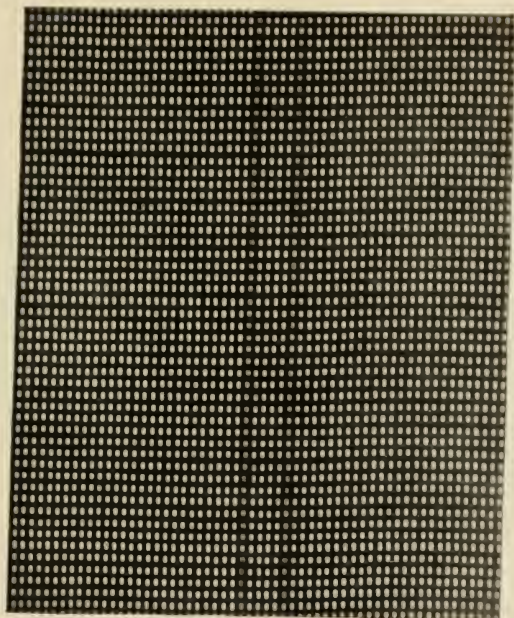


FIG. 79a. Streaks in dyed fabric.

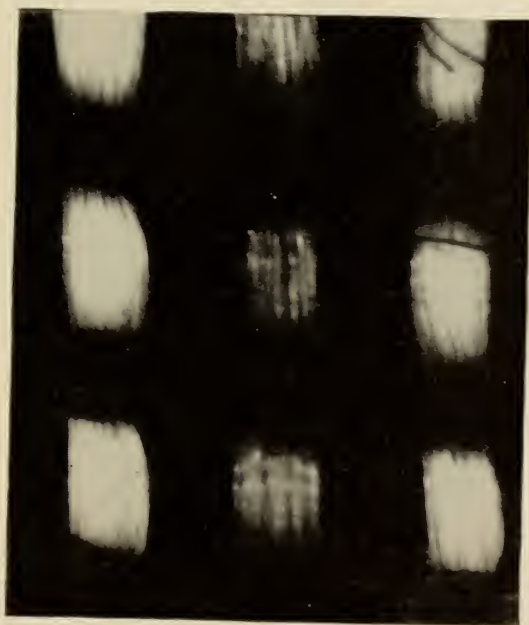


FIG. 79b. Deposit on white warp yarn.

CASE 3-17. WARP STREAKS

Fabric

Sharkskin-type dress goods

Construction

Count: 112×50

Warp: 150/40 dull acetate rayon

Filling: 15/1 50% 2-in. 3-den. dull viscose rayon
50% 2-in. 3-den. dull acetate rayon

Finish

Plain dyed light blue

Defect

Irregular warpwise streaks

Analysis

Inspection of the full piece showed several irregular streaks running in a warpwise direction on one face of the cloth only and varying from $\frac{1}{4}$ inch to 1 inch in width. Microscopic examination revealed a marked distortion of the filaments in the warp yarns in the streaky sections. Since there was no evidence of any gray-goods condition which could have been responsible for this damage, it was assumed that the defect was caused in finishing, probably by rubbing over some rough surface, but that it was not severe enough to rupture any of the yarns.



FIG. 80*a*. Normal area.



FIG. 80*b*. Streaky area—note warp yarn distortion.

CASE 3-18. SPOTS DURING PRESSING

Fabric

Dress goods

Construction

Count: 108 \times 84

Warp: 30/1 combed cotton

Filling: 40/1 combed cotton

Finish

Plain dyed in three shades: purple, green, and blue

Defect

Customer claimed that fabric showed spots during pressing.

Analysis

One set of finished fabric samples was spotted in the laboratory with water and pressed with a hand iron. Another set was merely water-spotted and allowed to dry without ironing. In each case, the tests were repeated after soap scouring and ironing of all samples. It was found that only the purple-dyed cutting spotted easily both in the original state and after scouring. The blue-dyed sample showed slight staining in the original state, but not after scouring. These two colors also showed a distinct change in shade under hot pressing.

It was concluded that the purple dyestuff was sensitive to both moisture and dry heat, whereas the blue-dyed fabric contained a finish which was sensitive to water-spotting only. Both of these faults were considered the dyer's responsibility.

CASE 3-19. UNREMOVED TINT

Fabric

Spun-viscose-rayon-and-acetate suiting

Construction

Count: 48×44

Warp: $24 \frac{1}{2}$ 60% 2-in. $1 \frac{1}{2}$ -den. bright viscose rayon
40% 2-in. 3-den. dull acetate rayon

Filling: Same as warp

Finish

Boiled off only

Defect

Finisher reported that the red tint was not fugitive.

Analysis

Laboratory scouring tests in $\frac{1}{2}\%$ of neutral soap solution at 180°F . completely eliminated the red tint present in the gray goods. On visiting the finisher's plant and attempting to repeat the scouring operation in a pail on $\frac{1}{2}$ -yard cuttings, using soap supplied by the finisher, the investigators found that the tint could not be completely removed. A sample of the soap was analyzed and it was evident that it was very inferior in detergent properties when compared with a standard grade of neutral soap. Further investigation revealed that it was a poor-quality product which the finisher had purchased for several cents a pound less than the market price for commonly used commercial soap. Under the circumstances, the gray mill assumed no responsibility for this defect and the finisher was obliged to use a stripping agent (sodium hydrosulphite) to destroy the tint on goods which he had already boiled off.

CASE 3-20. FILLING STREAKS

Fabric

Corduroy dress goods

Construction

Count: 76×140

Warp: 22/1 carded cotton

Filling: Same as warp

Finish

Plain dyed red

Defect

Rough-appearing streaks visible on the face of the finished fabric and running in a fillingwise direction for lengths of from 2 to about 10 inches

Analysis

The converter was advised by the dyer, who also carried out the cutting operation in the manufacture of the corduroy, that the gray goods were at fault, the raised streaky-pile effect being attributed to slubs or uneven twist in the filling yarn. When the filling-ground yarns from the portions of the fabric showing the streaks were raveled, it was found that the defect was not exactly parallel to the filling yarns. Furthermore, microscopic examination showed that the filling-ground thread in the defective places was cut through completely or partially. This was confirmed by trying to remove the filling yarn in the damaged sections and finding that it came apart with little or no tension. It was concluded that these imperfections were due to some fault in the cutting operation, the damage resulting in excess pile on the surface when the fabric was brushed.

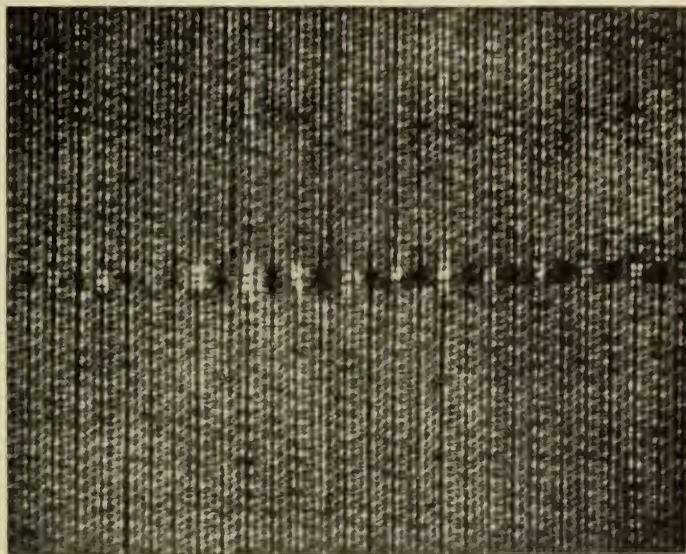


FIG. 81a. Streak viewed by transmitted light.



FIG. 81b. Cut ground yarns.

CASE 3-21. DIFFERENCE IN FINISH

Fabric

Spun-rayon-and-wool flannel sportswear

Construction

Count: 72×72

Warp: 24/1 30% 1½-in. 1½-den. dull viscose rayon
30% 2-in. 3-den. dull viscose rayon
40% 64's wool cut 2 in.

Filling: Same as warp

Finish

Plain dyed brown

Defect

Several pieces in the same dye lot had appreciably different hand, as well as a slightly different shade, from the major portion of the goods.

Analysis

Analysis of the samples of each shade and finish showed yarn count, size, twist, and composition to be identical. On the stripping of a swatch of each and the redyeing of only the rayon, the wool being left white, the same difference in shade was observed. It was noticed, however, that in the darker dyeing swatch the wool appeared much more compact and felted. Investigation of the dyeing procedure disclosed that this construction normally received a fulling or milling treatment, in processing prior to dyeing. Apparently some pieces had received more of this treatment than others, and it was concluded that the difference in the dyeing of the rayon, as well as the variation in hand, was due to this difference in the fulling of the pieces before dyeing.

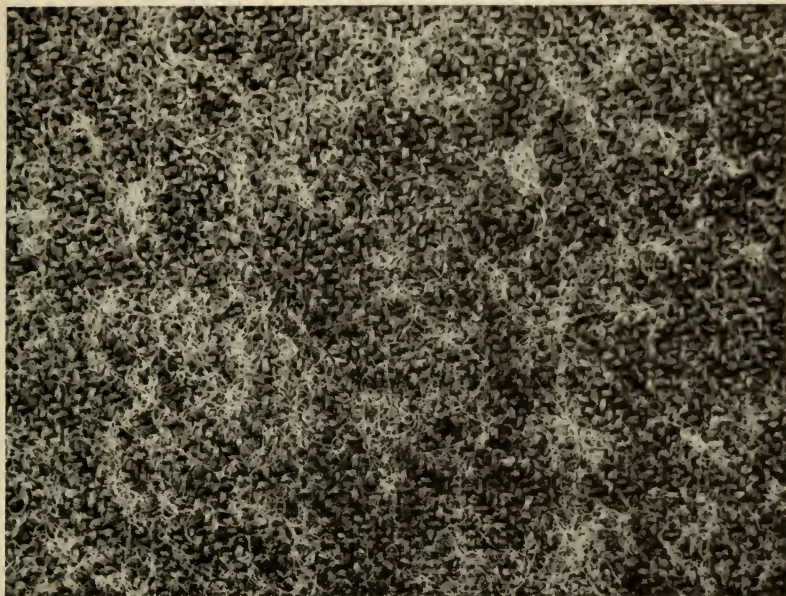


FIG. 82a. Normal—piece fulled before dyeing (cross-dyed to show wool appearance).

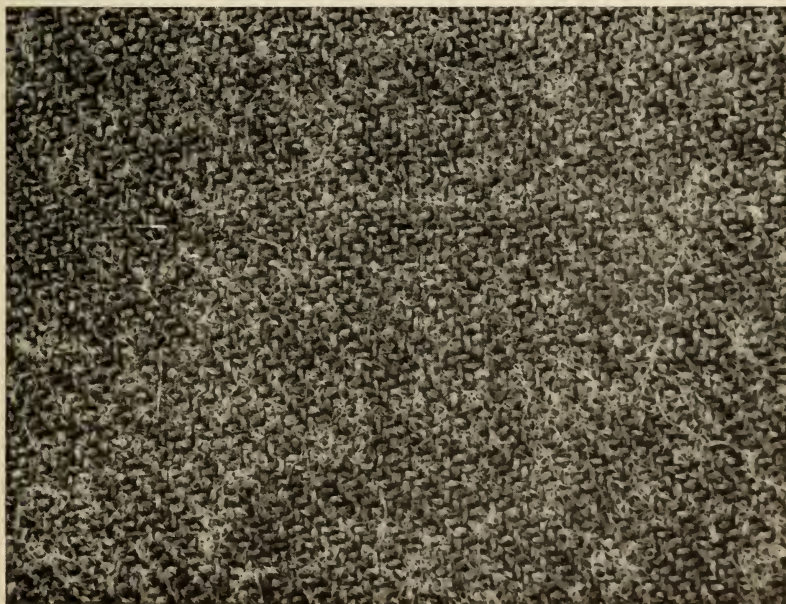


FIG. 82b. Defective—piece not fulled.

CASE 3-22. HOLES

Fabric

Rayon lining twill

Construction

Count: 112×68

Warp: 150/40 bright viscose rayon

Filling: Same as warp

Finish

Plain dyed gray

Defect

Small holes throughout the finished goods

Analysis

Examination showed that a large proportion of the holes were appearing at intervals of about 1 yard. There being no evidence of any finishing operation which would produce this type of damage, the investigation was continued by inspecting a large number of bales of gray goods. Eventually several bales were found which showed what resembled a mechanical chafing or bruising along the edges of several of the flat-folded pieces. When the additional goods being held at the finishing plant were checked, it was learned that similar damage had been found in the same type of fabric from two gray mills, located many miles apart. Microscopic analysis showed positive evidence of insect damage, in many cases only the warp yarns (containing sizing) being attacked. Traces of insect excrement were found around the damaged areas, and it was concluded that the defect was caused by silverfish at the finishing plant. Most of the damage occurred at approximately 1-yard intervals, because the gray goods were baled in flat, folded condition, and the folded edges, about 1 yard apart, were most readily accessible to attack.



FIG. 83. Insect damage to warp yarns.

CASE 3-23. MOTTLED APPEARANCE

Fabric

Flannel dress goods

Construction

Count: 80×76

Warp: 20/1 80% 2-in. $1\frac{1}{2}$ -den. dull viscose rayon
20% 2-in. 3-den. dull acetate rayon

Filling: 11/1, same blend as warp

Finish

Plain dyed dark blue

Defect

Over-all mottled appearance

Analysis

Examination under a pick glass showed that there was poor color match between the viscose and the acetate. It was found that by stripping and redyeing the viscose only, leaving the acetate white, the distribution of the acetate and viscose was not perfectly uniform. However, on redyeing in the laboratory to the original solid shade, but with more careful matching of the two fibers, the finished appearance was improved to such an extent that the two-tone mottled effect was completely eliminated. This defect was blamed on the dyer for carelessness in not obtaining a better match.

A similar effect may be found in fabrics which contain continuous-filament viscose- and acetate-rayon yarns that are not carefully matched in shade.

CASE 3-24. TENDER SPOTS

Fabric

Crepe dress goods

Construction

Count: 120×72

Warp: 100/40 dull viscose rayon

Filling: 100/40 bright viscose-rayon crepe woven 2 S and 2 Z

Finish

White discharge print on brown ground

Defect

Tender areas found throughout piece

Analysis

Tensile-strength tests made on portions of the piece showed that only the white-printed areas were tender. It was concluded that this defect was due to a processing fault in finishing, probably originating with washing at too high a temperature with an oxidizing agent after the discharge print had been applied with a sodium sulfoxylate paste. Similar damage may be encountered on delicate sheer fabrics, caused by embrittlement of the fibers by improper use of the thickener in the printing paste. In acetate-rayon fabrics, tender discharge prints are frequently attributed to the excessive weakening of the acetate yarns during the saponification treatment, prior to printing, or to improper use of swelling agents.

While the use of bleaching solutions is generally avoided, the printer might have resorted to it in this case in an effort to obtain a better white.

CASE 3-25. STAINS AND HOLES

Fabric

Rayon sport shirting

Construction

Count: 114 \times 48

Warp: 150/40 dull acetate rayon

Filling: 300/75 dull acetate rayon

Finish

Plain dyed cream

Defect

Stains and holes

Analysis

Examination of two full pieces showed discolored areas and fabric disintegration along one selvage. There was no regular pattern or repeat to this defect. The yarns in and around the stained places were very weak, and chemical tests showed a strong acid reaction. This defect was apparently caused in the finishing plant after the goods were dyed. If the damage had taken place in the gray goods, there would have been little or no acid remaining in the fabric after it had been wet-processed.

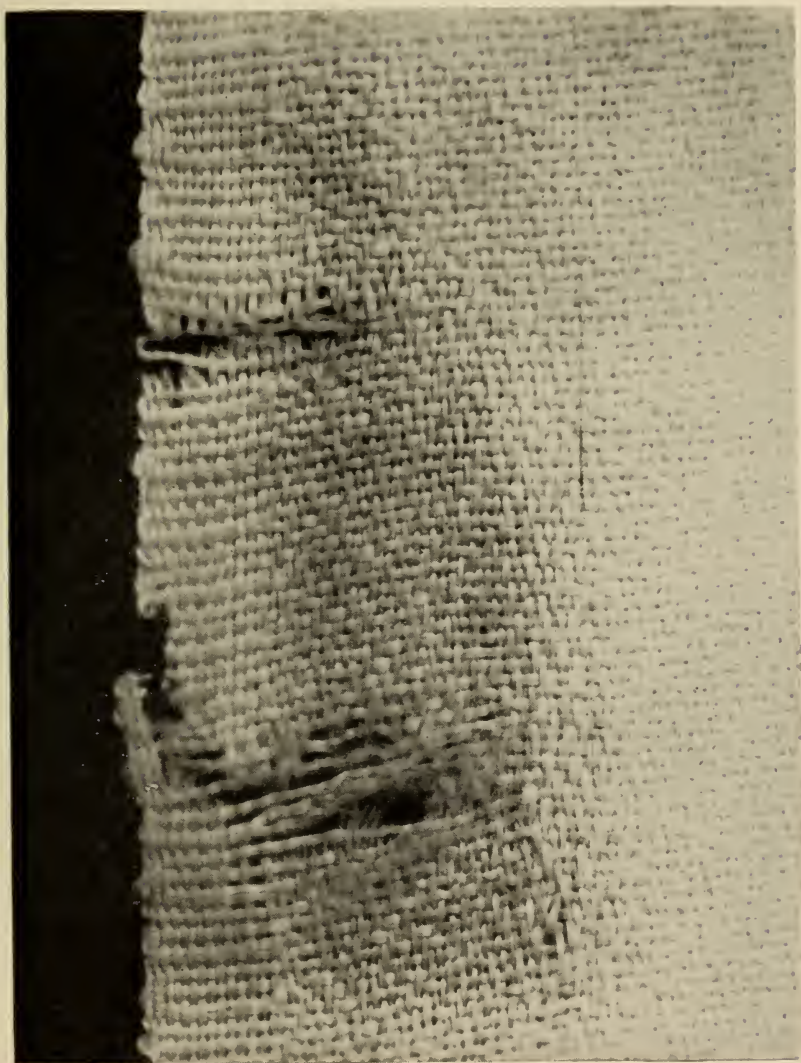


FIG. 84. Deterioration by acid.

CASE 3-26. BROKEN WARP ENDS

Fabric

Fancy shirting

Construction

Count: 100×60

Warp: 30/1 combed cotton and decorative stripes of 150/40
dyed bright viscose rayon

Filling: 40/1 combed cotton

Finish

Plain Sanforized

Defect

Black warp stripes broke out during the finishing.

Analysis

Single-strand breaking-strength and elongation tests made on the colored rayon yarns in a gray head end from the lot in question showed that the black yarns were significantly weaker than the other colors of dyed yarns. Investigation by the weaver disclosed the fact that the commission dyer who had processed the rayon yarns had used a lot of previously dyed yarn and had redyed it black. The extra handling had resulted in excessive tendering of the yarns. Evidently the lowered breaking strength and elongation of the redyed black yarn were bad enough to result in the rupture of those ends in the normal finishing of the woven fabrics.

CASE 3-27. FILLING BANDS

Fabric

Pigment-taffeta dress goods

Construction

Count: 92×68

Warp: 100/60 dull viscose rayon

Filling: 150/90 dull viscose rayon

Finish

Aqua-ground print

Defect

Filling shade bands starting and ending at shuttle changes

Analysis

Analysis of the filling yarn in representative dark- and light-dyeing bands revealed no physical differences. Laboratory strip-ping and redyeing to the same shade, using a level dyeing color which had light and washfastness properties equal to that of the ground shade in the original, resulted in complete elimination of the bands. Although it must be acknowledged that, while the rayon yarn was basically at fault in its tendency to dye unevenly, it appeared that the dyer had not used a dyestuff suitable for level dyeing of rayon or had been careless in his dyeing procedure.

The warp also showed a slight amount of streakiness, and this, too, was eliminated in the redyed samples.

CASE 3-28. WARP STREAKS

Fabric

Sharkskin-type dress goods

Construction

Count: 120×52

Warp: 150/40 dull acetate rayon

Filling: 300/80 dull acetate rayon

Finish

Plain dyed blue

Defect

Three narrow streaks running in a warpwise direction

Analysis

Inspection of several yards of the pieces submitted showed that the streaks did not follow the warp yarns exactly. Microscopic examination showed that the filling yarns were bruised in the streaky areas. As the streaks were dyed darker than the remainder of the fabric, it was assumed that the damage was due to a chafing before dyeing. Inasmuch as there was no indication of any such condition's having been present in the gray goods, it was decided that this defect was introduced at the finishing plant, prior to dyeing.

While it is difficult to suggest where such a damage might have been inflicted, two occasions for possible chafing would be during the beaming of the piece just before putting the roll on the jig, or during the boil-off.

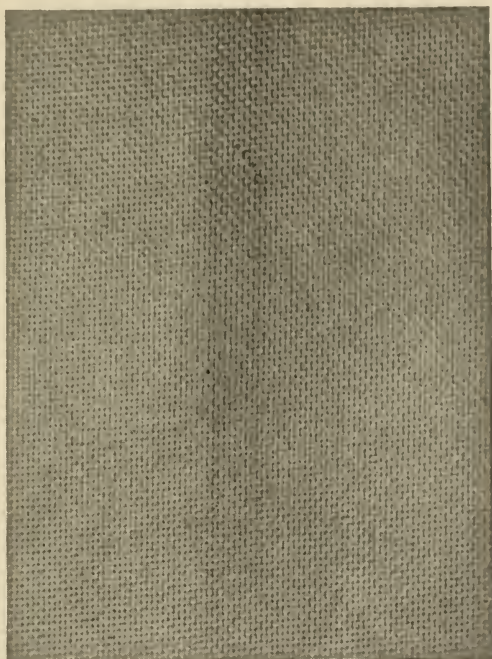


FIG. 85*a*. Streak due to bruise.

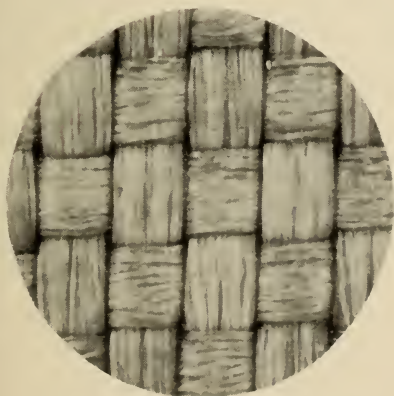


FIG. 85*b*. Normal area.

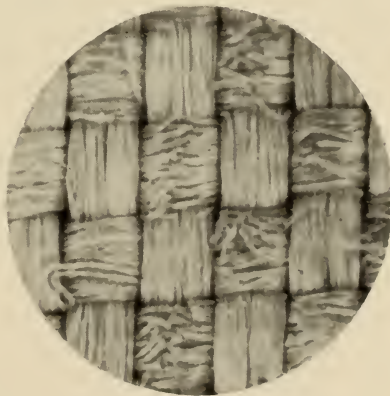


FIG. 85*c*. Bruised filling.

CASE 3-29. WARP STREAKS

Fabric

Gabardine sportswear

Construction

Count: 106×58

Warp: 20/1 50% 2-in. $1\frac{1}{2}$ -den. dull viscose rayon
50% 2-in. 3-den. dull viscose rayon

Filling: Same as warp

Finish

Plain dyed gray

Defect

Over-all warp streakiness

Analysis

Laboratory tests on the finished goods showed the presence of unremoved starch-base warp sizing. After desizing and stripping and redyeing, the general warp streakiness was completely eliminated. There have been numerous cases in which the finisher has not removed warp sizing, so as to retain a firmer hand without adding sizing or stiffening agents in his final finishing treatment. In some constructions and in some shades, this incomplete removal of warp sizing does not necessarily result in streaky dyeing. In other instances, when the dyer has been careless in desizing and has then used a starch finish, he has assumed that it would be impossible to determine whether or not the desizing operation had been carried out before dyeing. However, such finish usually comes out in hot water alone, and the original warp sizing can still be detected by chemical test. The weaver can reasonably disclaim any responsibility for warp streakiness in cases in which there is evidence of unremoved warp sizing, especially if tests prove that such sizing is readily removable when an enzyme is used.

CASE 3-30. "DUSTING" OF FINISHED GOODS

Fabric

Cotton-and-rayon dress goods

Construction

Count: 60×56

Warp: 30/1 combed cotton

Filling: 24/1 70% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon
30% $1\frac{1}{2}$ -in. 60's Aralac

Finish

Light-blue-ground print

Defect

Converter claimed that the fabric "dusted" excessively when the goods were being inspected on the examining machine, or even when they were shaken.

Analysis

Chemical and microscopical analysis of the "dust" accumulated from the spreader bars of the examining machine showed it to be composed chiefly of small bits of Aralac fiber. In processing fabrics containing Aralac (a casein-base fiber, production of which has been discontinued), it is essential that precautions be taken to avoid strongly alkaline solutions and to finish the goods on the slightly acid side. In this particular case, the dyer was inexperienced in handling fabrics containing such fiber and apparently subjected the goods to strong alkaline treatment, particularly because of the cotton warp, with the result that the Aralac fiber was left in an extremely brittle state. Any rough handling or rubbing of the fabric broke off small particles of the brittle fiber, causing the "dusting." When Aralac was eventually put into greater use and dyeing and finishing techniques were improved, this defect was overcome almost entirely.

CASE 3-31. CRACKY WARP

Fabric

Dress goods

Construction

Count: 108×40

Warp: 150/40 dull acetate rayon

Filling: 10/1 50% 1½-in. 1½-den. bright viscose rayon
50% 1½-in. 3-den. dull acetate rayon

Finish

Plain dyed light blue

Defect

Cracky appearance in warp

Analysis

Examination showed the sample submitted to have short warpwise cracks or open spaces across the full width of the piece. Determination of pick count disclosed the fact that the finisher had given only 2% warp shrinkage to the piece in question. Reference cuttings of the same style had a normal finishing shrinkage of about 8%. The defective piece was also finished about 1 inch wider than was recommended for this construction. It was therefore concluded that this defect was due to inadequate warp shrinkage and excessive width in finishing.

Although the gray mill has no control over the converter or finisher and cannot dictate how goods are to be processed, the converter is usually guided by the appearance of one or more finished sample pieces. If he chooses to process the gray goods in an unorthodox manner, he must, of course, assume all responsibility for any abnormal finished appearance.

CASE 3-32. MOTTLED APPEARANCE

Fabric

Novelty yarn-dyed piqué

Construction

Count: 108 × 96

Warp: 35/1 cotton, one end dyed red alternating with one end of white

Filling: 40/1 cotton

Finish

Bleached and preshrunk

Defect

Uneven mottled appearance

Analysis

Examination of a cutting showed that the red-dyed warp yarn had lost considerable color in some areas. There was no definite continuity or regularity to the shading of color. Laboratory scouring and bleaching tests indicated that the colored yarns were dyed with a dyestuff that resisted all scouring and bleaching which would normally be employed in finishing fabrics of this type. The only way in which it was possible to duplicate the change in shade was by use of a sodium hydrosulphite stripping agent.

Apparently these goods were given an abnormally severe bleaching treatment in finishing, which could not be duplicated in the laboratory. It is possible that the finisher noticed a slight bleeding of excessive surface color during boil-off and attempted to eliminate the danger of staining of the white yarn by using a sodium hydrosulphite stripping bath.

CHAPTER 4

DEFECTS IN GARMENTS

Defects in garments are due basically to (1) faults in the original gray goods or dyeing and finishing imperfections which escape detection and do not become apparent until the garment is cut and made up, (2) carelessness in the manufacture of the garment, or (3) degradation resulting from abuse by the wearer or in the washing or dry cleaning of the garment. Technically, therefore, a number of the defects recorded in the following section rightfully belong in some of the classifications previously discussed. However, as these facts were not ascertainable until the analysis had been made, and as the complaints did not come to the investigator's attention until the finished garments were returned, they are placed in the one category.

From the standpoint of the weaving mill or the dyer and finisher, it would have been much more desirable if those conditions for which they might have been responsible had been called to their attention before the garments were made. Otherwise, of course, the losses are likely to be much greater and the inconvenience to the cutter much more serious, because they may result in unfilled orders or late deliveries. It is common practice for the converter or the mill to refuse to accept responsibility for faults or imperfections discovered after the goods have been cut. This stand, of course, applies only to such defects or imperfections as are patent, or can be readily seen under normal conditions, as contrasted with so-called "latent," or hidden, imperfections. For example, uneven dyeing properties of rayon yarn cannot be detected by a weaving mill until the goods are dyed; hence, these would be recognized as latent defects in any controversy between the weaver and the yarn producer. On the other hand, the same fault, resulting in filling shade bands in the dyed and finished goods would be considered

a patent defect in goods delivered to a cutter; therefore, he would be expected to notice and report this condition to the converter before cutting the pieces. At times, there is a question of responsibility for deciding which are latent defects and which are not, the controversy arising from the fact that the fault becomes one of degree. Thus a shaded condition from one end of a piece to the opposite end, or a slight shading from selvage to center in a piece of plain dyed goods might very well be overlooked by a cutter until after a number of garments had been cut and sewed.

The end use to which a fabric is put can also be of prime importance in deciding whether or not a particular material is defective. An example described elsewhere involves the use of a dress fabric for umbrella tops, in which case a comparatively insignificant imperfection must be considered a major flaw. Cotton dress goods dyed with a certain class of colors might be ideally suited for children's play suits, but would fail miserably if the manufacturer decided to use the same fabric for swim suits which were subsequently used in a pool containing chlorine for antiseptic purposes. A rayon-gabardine material given an ordinary finish might serve admirably in a woman's sport dress which would normally be dry-cleaned, but it might show excessive shrinkage and loss of color if it were put into men's washable sport shirts. Obviously, thorough knowledge and understanding of the purposes for which particular fabrics are bought or sold would often go far toward averting complaints and consumer dissatisfaction.

It is not the purpose of this discourse to pass on the justification of the buyer or the seller in such matters, but simply to present factual case histories which may serve as illustrations of a number of garment defects. It is sometimes extremely difficult to arrive at a correct finding in the examination of returned pieces of wearing apparel, because in many cases—for instance, when the garment has been worn—an article has already passed through a number of hands. The consumer might have worn a dress, sent it to a commercial laundry, discovered some apparent defect, then passed the garment on to the retailer, who decided to return it to the garment manufacturer. The manu-

facturer may have taken it up with the converter, after which the converter, finding his dyer unsympathetic, finally has accepted the latter's suggestion that it be referred to the gray mill. Even when the matter is in the hands of what appears to be a single person, the retailer, it must be remembered that in a large establishment the returned article may have gone to a salesclerk, a section manager, a buyer, a merchandise manager, and a credit-department representative before being sent back to the cutter.

The problem is further complicated when one tries to obtain the true facts regarding what happened to the garment in the hands of the purchaser before it traveled along this line of intermediaries, since a verbal report easily becomes distorted.

It is most important for the analyst to know under what conditions the consumer discovered the fault, especially when there has been a color change or some deterioration of the fabric. Whether the garment was laundered or dry-cleaned, whether the cleaning was done at home or commercially, or whether some particular substance was spilled on it—these are all important bits of information which are helpful toward arrival at a successful and intelligent conclusion. Then, too, the consumer is sometimes inclined to withhold such information or deliberately to provide misinformation, in the belief that he will be in a better position to make a claim and recover the cost of the garment or obtain a replacement.

Fortunately or unfortunately, depending on one's interests, it is a fact—as any of the large department-store laboratories will testify—that the customer does not always complain when a garment has given unsatisfactory service. Consequently, it is not always safe to rely on the number of complaints in evaluating the seriousness of a particular defect. Besides, experience has taught us that the treatment of a garment is not always predictable or orthodox, whether it be in the hands of the consumer or of commercial launderers or dry cleaners. For example, although approved standard commercial laundry practice calls for the use of no chlorine bleaching agents on colored goods, many laundries feel obliged to use such chemicals for obtaining clean-appearing results on garments made of fabrics which con-

tain large areas of white grounds. Because of this, many dye-stuffs, though they may be properly selected as washable and may be well applied by the dyer or the printer, show excessive loss of color when the garments are laundered. Such abuse is just as likely to take place in home laundering, where control of temperature, quantity of bleach, and time are less accurately guarded than they would normally be in a good commercial laundry.

It is evident, therefore, that the problem of analyzing faults in returned worn garments is made even more difficult by factors beyond the control of weaver, dyer, finisher, or garment manufacturer. As a result, the technician is obliged to use not only all his laboratory skill, but also his knowledge of probable consumer use of garments, details of standard commercial laundry and dry-cleaning operations, and a great amount of tact in writing a report on his findings.

CASE 4-1. TORN SHIRT COLLARS

Garments

White cotton-broadcloth shirt collars

Fabric Construction

Count: 144×76

Warp: 80/2 combed cotton

Filling: Same as warp

Complaint

A shirt manufacturer returned a number of finished fused collars, claiming that the broadcloth was weak. The collars were made of two layers of white cotton broadcloth, laminated or fused with an inner lining of the type composed of cotton and regularly spaced ends of a cellulose acetate yarn, which acts as the bonding agent when the layers are subjected to a solvent for the cellulose acetate, along with heat and pressure. After the collars were made up, it was found that they tore apart very easily between the neckband and collar sections.

Analysis

Tensile-strength tests made on cuttings of the white broadcloth from which these collars had been made indicated that they were normal and up to standard. Several of the collars were softened by the application of a solvent and the stitches were carefully removed at the seams where the tearing took place. It was found that both warp and filling yarns were cut excessively, in some places most of the filling yarns having been completely severed. Also, stitch length showed extreme variation, running from 12 to 22 per inch. In collars in which there were only 12 stitches per inch, the cutting was correspondingly less pronounced and the tear resistance was comparatively high.

This defect was attributed to faulty sewing operations, resulting from the use of improper or dull needles.



FIG. 86a. New collar torn readily at seam.

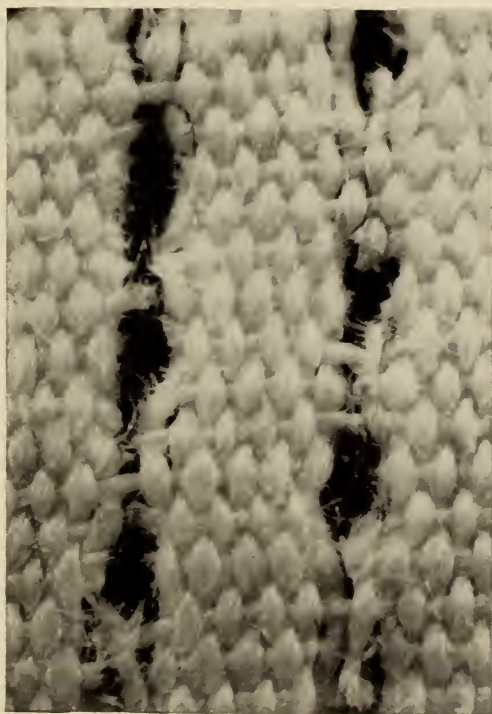


FIG. 86b. Needle cutting in sewing.

CASE 4-2. CHANGE IN SHADE

Garment

Woman's wine-colored chambray dress

Fabric Construction

Count: 120×112

Warp: 50/1 combed cotton, dyed wine

Filling: 50/1 combed cotton (white)

Complaint

Light-colored stains were discovered in various sections of the dress after the first laundering.

Analysis

Laboratory tests showed that the light-colored spots could be duplicated by dry pressing with a very hot iron. When the garment was dampened, the resultant temperature of the hot iron was appreciably lower, owing to the cooling effect of the moisture evaporated, and there was no change in shade. Apparently, the dress had been ironed with a very hot iron and the parts of the garment which had been sprinkled or dampened were unchanged in color, while the dry portions turned lighter in shade. Subsequent analysis revealed that the dyestuff used was sensitive to heat. However, since it required an ironing temperature in excess of 375°F. to produce this change, neither the mill nor the garment manufacturer was considered at fault for this apparent defect.

CASE 4-3. GREEN DISCOLORATION

Garments

Women's sharkskin-twill blouses

Fabric Construction

Count: 130×68

Warp: 100/40 dull acetate rayon

Filling: 150/40 dull acetate rayon

Complaint

A customer claimed that green blotches appeared in new white blouses after they were washed.

Analysis

Laboratory scouring tests made on the blouses showed that the green discoloration was removed in 0.5% soap solution at 180°F. in a few minutes. In checking with the finisher, it was found that the gray goods as delivered for finishing contained a green tint, which was supposedly fugitive. However, further tests revealed that this green tint, while apparently removed in normal finishing operations, gradually reappeared on exposure to very slight concentrations of acid. Also, the blouses, after washing, tended to become greenish again in some areas, probably because of exposure to certain normal atmospheric conditions. Investigation disclosed that the original yarn had been delivered with the green tint applied by the yarn manufacturer. It was concluded that the use of this particular dyestuff for identification was an improper choice on the part of the yarn manufacturer, on account of its peculiar characteristics. Therefore, its use was subsequently discontinued. The color was later identified as malachite green, a basic dyestuff.

CASE 4-4. TENDER FABRIC

Garment

Cotton poplin dress

Fabric Construction

Count: 80×56

Warp: 35/1 combed cotton

Filling: 20/1 combed cotton

Complaint

Customer reported that fabric in dress became tender and showed holes after only a little wear and comparatively few launderings.

Analysis

Breaking-strength tests confirmed the fact that the fabric in the dress was much weaker than should be expected after the little service which it was said to have had. However, careful examination and physical tests showed that the sewing thread was also appreciably weakened when compared with normal new sewing thread of the same size and quality as that used in making the garment. Chemical tests confirmed the presence of degraded cellulose, which is evidence of chemical deterioration, in both the fabric and the sewing thread. It was apparent, therefore, that the garment as a whole had been subjected to some severe chemical deterioration, probably in laundering rather than in wearing, and the supplier of the fabric could not be held responsible for this "defect."

CASE 4-5. RED STAINS

Garments

Women's blue spun-rayon dresses

Fabric Construction

Count: 102×52

Warp: 22/1 S 50% 2-in. $1\frac{1}{2}$ -den. dull viscose rayon
50% 2-in. 3-den. dull acetate rayon

Filling: Same as warp, but Z twist

Complaint

Small, round, red stains were found in dresses after they were removed from boxes in which they were shipped.

Analysis

Examination of several of the dresses showed that, in addition to isolated round, faint, reddish stains in various parts of the garments, there were similar distinct red areas behind each of the leather buttons down the front and on the sleeves. Chemical tests showed that the buttons gave an acid reaction, probably as a result of the method of finishing the leather used. Further tests confirmed the fact that the particular blue dyestuff used on the fabric turned red in the presence of acid. The less pronounced stains were apparently due to areas of contact with the buttons when the dresses were folded.

Obviously this was not the fault of either the converter or the dyer, since it is not unreasonable or uncommon for some blue dyestuffs to turn red in the presence of acid, and in normal usage such exposure to acid could not be anticipated.

As a further problem, the converter was anxious to know whether the stains could be eliminated to make the garments usable. Additional tests showed that merely exposing the red-denied areas to ammonia fumes, without actually wetting the fabric restored the blue color. By then substituting different buttons, the dresses were made salable.

CASE 4-6. EXCESSIVE WEAR

Garments

Men's gabardine shirts

Fabric Construction

Count: 98×50

Warp: 20/1 75% 2-in. 3-den. dull viscose rayon
25% 2-in. 1½-den. dull viscose rayon

Filling: Same as warp

Complaint

Several shirts were returned because of excessive wear at the collars and cuffs.

Analysis

Analysis of fabric construction and tensile-strength tests on cuttings of the fabric taken from the garments, as well as on finished file head ends, disclosed no significant difference. However, laboratory abrasion tests made on both new and worn shirts and the same file head ends showed the latter to be very much superior when subjected to the same number of abrasion cycles. Further analysis revealed that the reference head ends as well as the fabric in the shirts had approximately the same content of urea formaldehyde resin. The poor resistance to abrasion in wear was, therefore, attributed to some faulty operation in application of the resin.

Resin finishes are commonly used on rayon fabrics of this type to impart stability in laundering, and it should not be inferred that such finishes are normally detrimental to the wearing qualities of the fabrics to which they are applied. It must be noted, however, that the slightest lack of control during finishing—such as inadequate curing and polymerization, incomplete scouring, or overdrying—may contribute to the tendering or embrittlement of the fibers, with attendant loss of abrasion resistance.

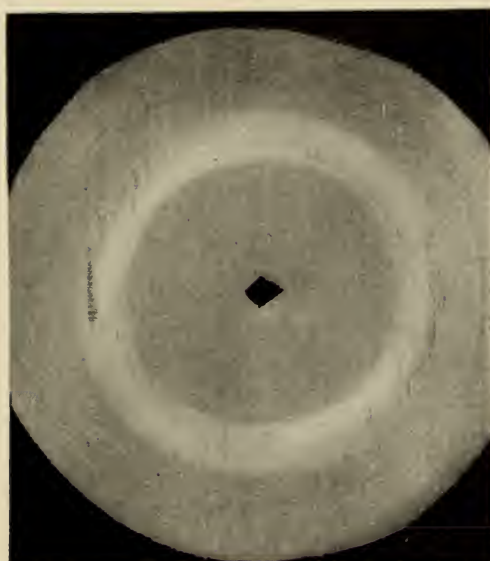


FIG. 87*a*. Fabric from returned shirts.

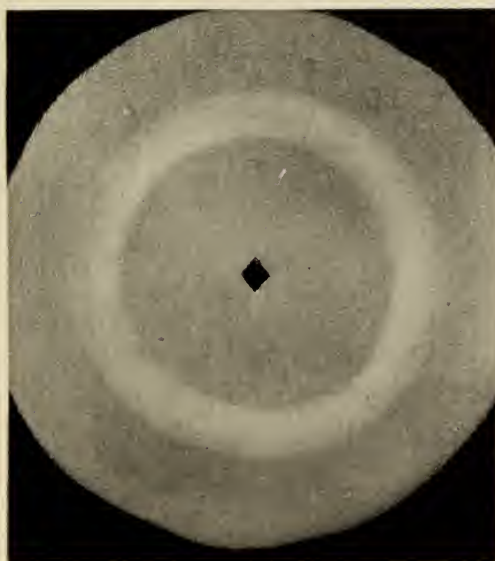


FIG 87*b*. Fabric from file head end subjected to same number of cycles on abrasion tester.

CASE 4-7. SHADE CHANGE IN SHIRT COLLAR

Garment

One new blue cotton shirt

Fabric Construction

Count: 136×60

Warp: 40/1 combed cotton

Filling: Same as warp

Complaint

The garment manufacturer claimed that the collar changed shade when the shirt was cut and sewed.

Analysis

Analysis showed that the shirt collar contained a large amount of starch, whereas the fabric in the body of the shirt contained none. When the starch was removed by desizing and scouring in the laboratory, it was found that there was actually no difference in shade between the collar and the remainder of the garment. Evidently the presence of the starch caused a slightly different light reflection, particularly noticeable in certain shades. Under the circumstances, the supplier of the fabric could not be considered responsible for this condition, because there was obviously no fault in the gray or the dyed goods. It was suggested that the shirt manufacturer try to obtain a similar stiffening by the use of some other type of starch or gum which would not cause such a marked change in appearance, or by the use of a sized interlining in the collar.

CASE 4-8. RUST STAINS

Garment

Man's ivory gabardine sport shirt

Fabric Construction

Count: 96×50

Warp: $20/1$ $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: Same as warp

Complaint

Very small rust stains were detected in a new shirt offered for sale by a retailer.

Analysis

Examination indicated that the rust stains were around the edges of pinholes, and it was concluded that they were caused by the rusting of pins put into the shirt by the garment manufacturer. It was later learned that the shirt had been in stock for a considerable length of time in a shop in Florida, close to the seacoast. Chemical analysis of similar pins showed that they were made of nickel-coated steel and that the protective metal surface was occasionally broken so that the under metal was exposed. On their immersion in salt water, to simulate their exposure to salt air, which was assumed to have occurred where the shirt had been kept by the retailer, it was found that the pins rusted very badly. This rusting would not have taken place, except after unusually long periods of exposure, if the shirt had been in a different atmosphere, or if the protective nickel coating had not been defective. The use of pins made of brass or some other nonrusting metal would have averted such damage.

CASE 4-9. HOLE AND WEAK SPOT

Garment

One pair of khaki cotton trousers

Fabric Construction

Count: 106×56

Warp: $36/2$ combed cotton

Filling: Same as warp

Complaint

The trousers were returned by the customer to the retailer because of a small hole and a single weak spot in the left trouser leg, adjacent to the seam.

Analysis

Laboratory tests revealed the presence of a small amount of sulphuric acid in the tender and slightly discolored area around the hole. Since the stained section was confined to one side of the trouser seam, it was evident that the acid must have come into contact with the fabric before it had been made up into trousers. Although it was impossible to determine whether the acid contamination had taken place before or after the material was received by the customer, it was assumed that this type of damage was more likely to occur at the finishing plant or in transit than in the plant of the garment manufacturer.

It is not unusual for the garments of gas station attendants to show damage from the spattering of automobile battery acid. In those cases, however, the stains or holes are more than likely to show on both sides of seams, in sewing thread, or even through two layers of the fabric.

CASE 4-10. YELLOWING BRASSIERES

Garment

White satin brassiere

Fabric Construction

Count: 218 \times 90

Warp: 55/20 bright acetate rayon

Filling: 75/24 dull acetate rayon

Complaint

Fabric turned yellow when made into brassieres.

Analysis

It was found that in the manufacture of the brassieres a rubber laminated fabric was attached to the lower portion, to provide a firm support. Laboratory tests showed that the yellowing of the fabric took place only in areas where it was in contact with the rubber laminate. Further experiments proved that a rubber accelerator compound was responsible for the discoloration of the acetate rayon and that even the cotton backing which adhered to the rubber yellowed in time. The manufacturer was advised to try to obtain some other backing product for making these garments.

CASE 4-11. FRAYED SEAMS

Garments

Men's gabardine sport shirts

Fabric Construction

Count: 96×50

Warp: 20/1 85% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. dull viscose rayon
15% 2-in. 3-den. dull acetate rayon

Filling: Same as warp

Complaint

Seams had a frayed or "fuzzy" appearance.

Analysis

Inspection revealed that what appeared to be frayed or fuzzy seams, particularly noticeable where there were several thicknesses of fabric stitched together, such as at the collars and on the pockets, were actually a series of cut filling threads extending beyond the seams. Tensile-strength tests in those sections showed the seams to be abnormally weak and when the sewing thread was removed, it was found that the yarns had been badly cut during sewing. Tests were made on many other sections of several shirts which had been returned and it was found impossible to sew through several fabric layers without obtaining an abnormal amount of needle cutting.

With the application of a small amount of softener (as a lubricant) it was found that the needle cutting was completely eliminated. In this case the fault was traced to one small lot of finished goods which had been improperly processed at the finishing plant.

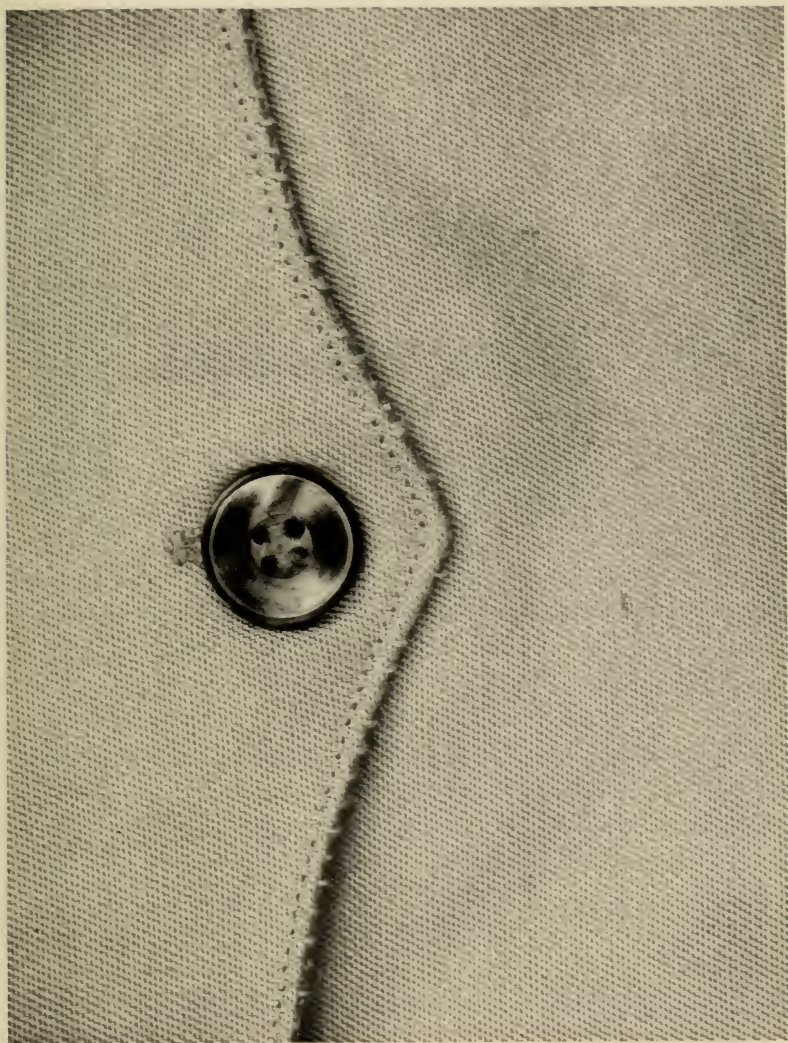


FIG. 88. Frayed appearance due to needle cutting.

CASE 4-12. REDDENING OF BLUE DRESS

Garment

Blue taffeta dress

Fabric Construction

Count: 200×64

Warp: 100/40 bright acetate rayon

Filling: Same as warp

Complaint

The dress turned reddish in shade in various areas.

Analysis

From a general examination it was evident that this defect was due to so-called "gas fading." Many acetate dyestuffs, particularly some blues and mixtures containing those blues, are subject to change, generally to a reddish shade, when exposed to certain atmospheric gases present in varying amounts in almost any locality. Considerable progress has been made in the development of special dyestuffs which are resistant to gas fading and to the introduction of chemical inhibitors which, if properly applied, eliminate or reduce to a minimum the tendency to gas-fade. When certain dyers exercise extreme care in dyestuff selection and in the application of inhibitors and subject representative dye lots to constant testing, they have offered guarantees against gas fading, usually charging a premium for this extra quality of performance. Other dyers and finishers, as well as converters, will merely guarantee the use of selected colors or inhibitors, also check-testing the dyed goods regularly; but they do not assume responsibility if any complaints arise.

CASE 4-13. UNEVEN PANELS IN SLIPS

Garments

Women's rayon slips

Fabric Construction

Count: 150 × 94

Warp: 75/50 dull acetate rayon

Filling: 75/30/35 bright viscose rayon

Complaint

The panels of the slips varied in length after sewing.

Analysis

Analysis of the fabric in the various panels of several slips submitted showed no significant differences in construction, finishing shrinkage, or finish. Inspection of the garments during the laying out of the full pieces and the cutting indicated careful operations on the part of the garment manufacturer. After the cut panels were sewed, however, a number of slips showed the uneven panel length, although measurements were carefully controlled when they were cut. It was noticed that several of the full-finished pieces were framed slightly on a bias, or off square, a condition which was not corrected when the goods were spread out for cutting. Consequently, after these pieces were cut, the panels straightened out while being sewed, producing the uneven lengths. This was considered to be a finishing defect due to carelessness in framing the goods and was readily corrected when called to the attention of the dyer.

CASE 4-14. HOLES IN TABLECLOTH

Article

White cotton striped damask tablecloth

Fabric Construction

Count: 78×46

Warp: 18/1 cotton

Filling: 17/1 cotton

Complaint

Holes appeared in cloth after it was laundered once.

Analysis

Physical tests confirmed the fact that the fabric was excessively weak in certain areas. Chemical tests for oxycellulose were positive, indicating that the tendering was produced by some corrosive chemical agent. When the history of the fabric was traced, it was learned that these goods were given a so-called "permanent" finish, involving the use of an alkaline viscose (cellulose) solution, which was applied and then precipitated in the fabric by treatment with a mineral acid. Under the circumstances, it was assumed that the finisher, rather than the consumer or the laundry, was more likely to have been responsible for this condition. Apparently some pieces of fabric had been finished without having been adequately neutralized or rinsed after the acid treatment. This assumption was evidently a correct one, because at a later date several more complaints developed on similar tablecloths made from the same lot of finished goods.

CASE 4-15. PINK STAINS

Garment

White cotton nurse's uniform

Fabric Construction

Count: 120 \times 54

Warp: 32/1 cotton

Filling: 17/1 cotton

Complaint

Pink stains on the white collar and the back portion of the uniform near the collar were noticed before laundering.

Analysis

Analysis indicated that the pink stains were due to the chemical reaction between traces of chlorine (from bleach) or alkali left in the fabric and the volatile fumes of an aniline black marking ink which had been used as identification on the inside of the collar of the garment. This pink color (probably a red fuchsine) was fairly easily removed by a laboratory scour.

It is interesting to record the fact that a similar defect was encountered in garments on several other occasions, one involving several pairs of white Army twill trousers, which showed the staining after having been marked with the garment size and other data on the inside waistband. Another case concerned some white cotton knitted athletic or gym shirts stencil-marked on the chest portions with large black letters, evidently to represent the purchasers' organization or athletic team. The marking had been done with an aniline black ink and there was a pink halo around each of the black letters. It was concluded that the new shirts had left the bleachery without complete removal of the chlorine bleach used in regular processing. Here again, the condition would have gone unnoticed and no harm would have been done, except for the unforeseen use of the aniline black marking ink.

CASE 4-16. COLOR FADING

Garment

Woman's piqué dress (yellow ground, black print)

Fabric Construction

Count: 116 \times 84

Warp: 34/1 combed cotton

Filling: Same as warp

Complaint

The customer claimed that the color faded during laundering.

Analysis

Laboratory tests for colorfastness to laundering and sunlight (Fade-Ometer) showed no evidence of color fading in excess of established minimum standards. Inspection showed the presence of large stains, the outer edges of which were green, near the bottom of the dress. Careful examination disclosed the presence of several small blotches of green paint not far from the larger stains. It was concluded that the garment had come in contact with wet paint and that an attempt had been made to remove the stains through the use of some solvent, which was responsible for the large blotches outlined by greenish rings.

This is typical of an unjustifiable consumer complaint in which it is difficult to believe that the owner of the garment did not know exactly what had happened. If the retailer had been one of the larger department stores, many of which have their own testing laboratories, or retain a commercial laboratory, the garment would never have been returned to the fabric manufacturer.

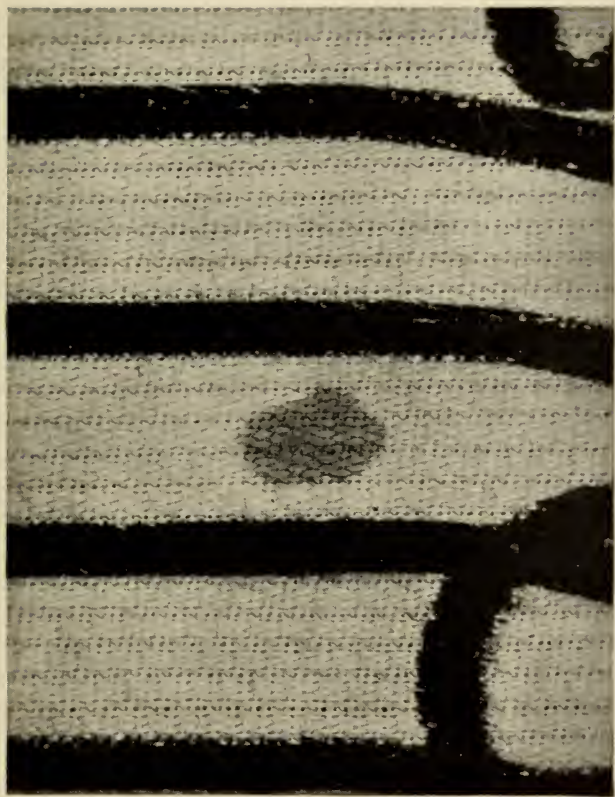


FIG. 89. Paint stain on white portion of printed fabric.

CASE 4-17. YELLOW STAINS

Garments

New white cotton-broadcloth shirts

Fabric Construction

Count: 136×60

Warp: 40/1 combed cotton

Filling: Same as warp

Complaint

Slight yellow discoloration was detected in sections of the garments after the shirts were cut and sewed.

Analysis

Laboratory tests indicated that the fabric discoloration was not due to any fault of the garment manufacturer. It was possible to remove this yellow color by laboratory bleaching. The conclusion was reached that the goods as delivered to the cutter had contained some pieces or some portions of pieces that were not so white as the standard. Although it was impossible to determine from the few shirts submitted the exact cause of the condition, it is very probable that it was due to kier stains, or "channeling" of the liquor during the kier-boiling operations. When this takes place, some sections of the cotton fabric do not receive adequate solution contact to cause destruction of the natural cotton coloring matter. Also, in some instances a yellowing of the fabric after bleaching may be due to the presence of unremoved cotton wax.

CASE 4-18. TENDERING AND HOLES

Garment

White broadcloth shirt

Fabric Construction

Count: 144 × 76

Warp: 80/2 combed cotton

Filling: Same as warp

Complaint

A white broadcloth shirt returned by the wearer to the shirt manufacturer after only a few wearings showed tendering and some small holes in the areas under the arms.

Analysis

Chemical tests made on the fabric in the tender sections showed the presence of small amounts of hydrochloric acid. This is a fairly common complaint, more often appearing in women's cotton, linen, or rayon dresses, and usually traced to the use of under-arm deodorants. These compounds frequently contain aluminum chloride as the active ingredient. Careless or repeated use of such materials is definitely detrimental to cellulosic fibers because of the formation of hydrochloric acid, which has a tendering effect. In many cases the user probably applies the deodorant and then puts on a garment before the solution has a chance to dry on the skin or, if a paste is used, he allows some of it to come into direct contact with his clothing. It is obviously impossible for any garment or fabric manufacturer to take the responsibility for damage of this type; but fortunately the manufacturers of such products, as a rule, warn the user of the likelihood of such damage or, today, use chemical compounds which are comparatively harmless to textile materials.

CASE 4-19. REDDENING OF SHIRT COLLAR

Garment

Man's new tan sport shirt

Fabric Construction

Count: 120×54

Warp: 120/40 dull acetate rayon

Filling: 18/1 50% 2-in. 3-den. dull viscose rayon
50% 2-in. 3-den. dull acetate rayon

Complaint

Collar points turned reddish before shirt was worn.

Analysis

Inspection showed that the slight change in shade was confined to those sections of the collar where the plastic collar stays had been inserted. It was found in laboratory tests that the tan color of the shirting could be made to redden slightly by exposure to nitric oxide. The collar stays had a marked odor, and it was assumed that the color change was caused by some decomposition of the celluloid stays after they had been in contact with the shirt and was not to be accounted for through any fault of the fabric or the dyestuff.

The shirt manufacturer later advised that this finding was evidently correct since he made up a number of garments from the same lot of fabric but used a different lot of stays and had no further complaints.

CASE 4-20. COLOR LOSS IN CLEANING

Garment

Printed waffle-piqué dress, ground dyed pink

Fabric Construction

Count: 104×76

Warp: 30/1 combed cotton

Filling: 40/1 combed cotton

Complaint

A customer claimed that pink color disappeared when the garment was dry-cleaned.

Analysis

Laboratory tests made on a file head end from the same finishing lot confirmed the fact that the pink ground color did not withstand dry cleaning with the chlorinated hydrocarbon type of solvents (carbon tetrachloride, perchlorethylene, trichlorethylene). Standard laboratory wash tests, on the other hand, proved that the color was fast to laundering. Further investigation disclosed that the dyer was using pigment colors because of their superior lightfast and washfast qualities in this particular shade. Unfortunately, these colors are applied with binders which are soluble in certain organic solvents. Inasmuch as it was understood that the fabric was sold as washable, the converter disclaimed all responsibility in cases in which garments had been dry-cleaned instead of laundered.

This decision could be questioned if the consumer had stained the dress with oil, grease, or a similar material and had tried to remove the stain at home with the usual household dry-cleaning solvents, but apparently that type of complaint was not common enough to warrant a change in the method of dyeing these goods.

CASE 4-21. WEAK SPOTS

Article

White pillowcase

Fabric Construction

Count: 68 × 72

Warp: 30/1 carded cotton

Filling: 40/1 carded cotton

Complaint

Customer returned a single new pillowcase to the retailer because of weak spots.

Analysis

Physical tests showed tendering of the cotton in several spots at one end of the pillowcase and chemical tests indicated the presence of oxycellulose in those places. The condition was found to exist on both sides of a seam, with no noticeable tendering of the cotton sewing thread at the seam. Test for starch in the pillowcase was positive, but none was found in the sewing thread or the attached cotton identification label. This was considered proof of the fact that the customer had not laundered the pillowcase. It was concluded that the defect was caused by some damage in the original finished sheeting before it was cut and sewed, probably the result of overbleaching by the finisher.

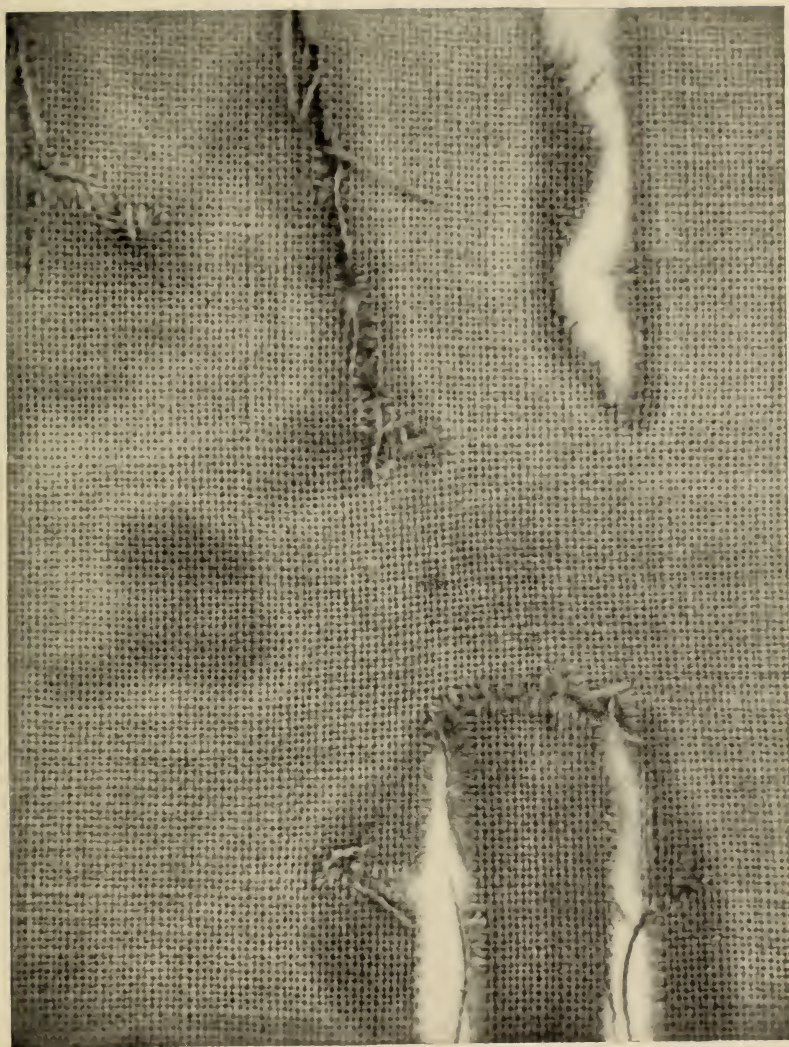


FIG. 90. Tender areas probably due to overbleaching by the finisher. (Dark stains are from methylene blue reagent used to detect presence of oxycellulose.)

CASE 4-22. WRINKLE IN COLLAR

Garment

Man's white broadcloth shirt with attached, fused collar

Fabric Construction

Count: 136×60

Warp: 40/1 combed cotton

Filling: Same as warp

Complaint

A wrinkle was observed in the back portion of the fused collar which was not removed after laundering and pressing.

Analysis

In the particular garment submitted, the collar lining which is the base fabric for manufacture of the fused or starchless "permanent-stiff" construction was woven with one end of acetate-rayon yarn in the warp, alternating with two ends of cotton yarn. The acetate ends are so woven in as to permit the subsequent fusing or bonding operation, usually consisting of a solvent and heat application to the two outer layers of shirting broadcloth, forming a "spot-welded," laminated collar. Analysis of the collar in the returned shirt showed that, where the wrinkle was present, one end of acetate warp yarn was missing, and that this resulted in an open nonfused section. This was obviously a weaving fault which passed by gray- and finished-goods inspection unnoticed.

CASE 4-23. BAD ODOR

Garments

Women's dresses

Fabric Construction

Count: 64×64

Warp: 30/1 85% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon
15% 58's wool cut $1\frac{1}{2}$ in.

Filling: Same as warp

Complaint

A large number of finished dresses were returned by the customer because of a pronounced "fishy" odor.

Analysis

Investigation revealed that all of this fabric had received a urea formaldehyde resin treatment to impart resistance to creasing, followed by a water-repellent finish. The combination of insufficiently cured or polymerized resin and one of the ingredients in the water-repellent formula resulted in the formation of amine compounds with a distinct fishy odor. This condition did not develop until after the goods had left the finishing plant and had been cut into a large number of garments. Fortunately, the finisher was able to expose the finished garments to a chemical-vapor treatment which eliminated the unpleasant odor. It was also possible to refinish the uncut piece goods so as to correct this condition.

The development of unpleasant odors in resin-finished goods is cause for frequent complaints by garment manufacturers and consumers. In some cases the sharp odor of formaldehyde may be detected, but more often the fishy odor predominates. Thorough washing after resin application and curing is generally carried out by the finisher to remove any unpolymerized resin which may contribute toward the liberation of such odors.

CASE 4-24. DISCOLORATION IN COLLARS

Garments

Men's gray broadcloth shirts

Fabric Construction

Count: 136×60

Warp: 80/2 combed cotton

Filling: 40/1 combed cotton

Complaint

A shirt manufacturer advised that fused collars turned reddish after the garments were delivered to the customers.

Analysis

Laboratory tests confirmed the fact that the fabric in the shirts was dyed with standard vat colors. On separation of the plies of the fused collar on one of the new shirts, which was returned, it was observed that the collar lining was slightly reddish in color. Laboratory spot tests made with acetone (one of the compounds generally used in the wet-fusing operation) showed a bleeding of the red component in the dyed broadcloth. Although the particular collar lining used in these shirts was of the thermoplastic-coated type, which permitted dry fusing without the use of any solvents, it appeared that one of the compounds in the coating had a solvent effect on the red dyestuff component. As it was understood that this particular shirt manufacturer had intended to use the dyed broadcloth for the fused-collar type of shirts, the dyer was considered responsible for not having selected a combination of dyestuffs which would not be affected by the chemicals generally used in this kind of collar lining, regardless of whether it was of the dry- or the wet-fusing process type.

CASE 4-25. WATER SPOTS

Garment

Woman's iridescent taffeta dress

Fabric Construction

Count: 160×68

Warp: 100/40 bright viscose rayon dyed blue

Filling: 150/40 bright viscose rayon (white)

Complaint

The dress became stained from water spots.

Analysis

Laboratory tests confirmed the fact that water spots stained this fabric and that dry-cleaning solvents did not eliminate the stains. Analysis disclosed the fact that the garment was made of gray goods in which the warp sizing had not been removed, in order that, without finishing, the goods might present a stiff effect. The warp sizing, being water-soluble, was partially dissolved when it came into contact with water (as it would from any water-containing liquid—fruit juices, soft drinks, milk, etc.). At the same time, the wetted warp yarns shrank when wet, producing a puckered effect, as well as a spotted area. Similar iridescent taffeta fabrics made of cellulose acetate rayon warps and viscose-rayon filling, cross-dyed in the piece, did not present this problem, because they contained no water-soluble stiffener. The type of fabric used in the stained garment could have been dry-cleaned, if handled very carefully, but wet cleaning would so alter the hand and appearance that it could be employed only at the owner's risk.

CASE 4-26. VANISHING STRIPES

Garment

One pair of men's all-cotton slacks

Fabric Construction

Count: 80 \times 48

Warp: 20/1 cotton

Filling: Same as warp

Complaint

A customer claimed that the slacks originally contained dark-brown stripes, which disappeared after the first laundering.

Analysis

Fabric analysis indicated that the material was essentially the same as that sold to the cutter, with the exception of the missing brown stripes. Reference head ends of the same style were checked in the laboratory and it was found that the brown warp yarns were dyed with sulphur colors. Sulphur colors do not resist chlorine bleaching, hence it was concluded that the slacks had been subjected to bleach in laundering. Although good commercial laundries do not normally bleach garments made of colored fabrics, certain articles which contain considerable white ground are often so badly soiled and stained that it is frequently necessary to risk bleaching rather than to have customers complain of improper cleansing.

The supplier of the fabric assumed no responsibility for this complaint, since the garment manufacturer knew that sulphur colors had been used and was aware of their lack of fastness to bleaching.

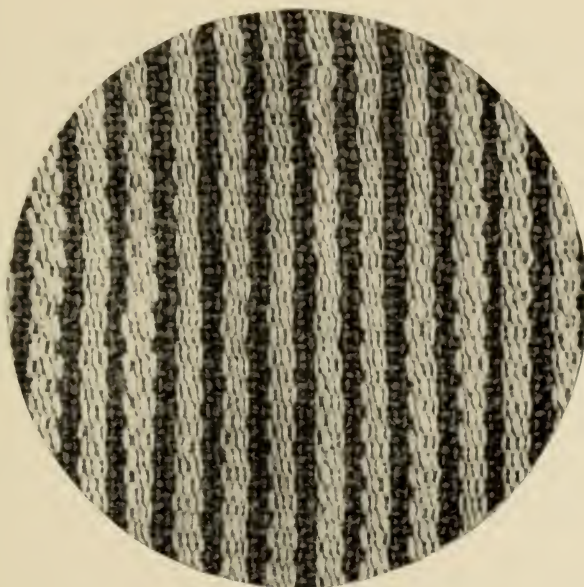


FIG. 91a. Original fabric.

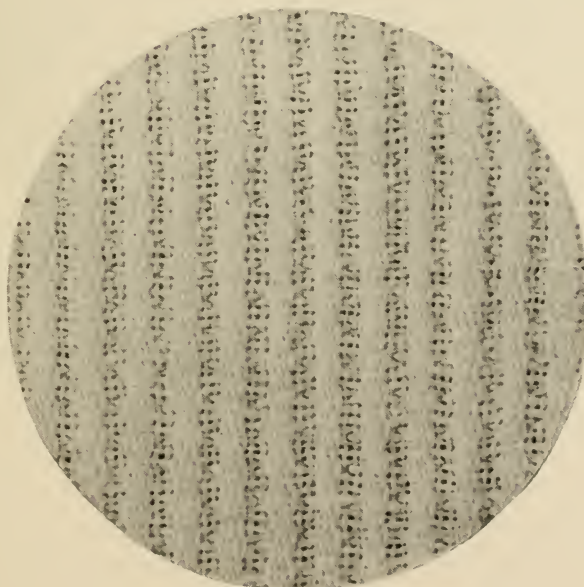


FIG. 91b. Fabric after bleaching.

CASE 4-27. CHANGE IN SHADE

Garment

Black satin slip

Fabric Construction

Count: 218×80

Warp: 55/20 bright acetate rayon

Filling: 300/80 dull acetate rayon

Complaint

A garment manufacturer returned a slip which a consumer had worn once and had washed in neutral soap, with the result that it turned from black to a reddish-brown shade.

Analysis

Swatches of a new black slip made from the same lot of finished goods delivered to the garment manufacturer were washed in a 0.5% neutral soap solution at 100°F., along with several cuttings of file head ends from other black-dyed lots. The swatches from the slip turned to a reddish-brown shade, similar to the color found in the worn slip, whereas the reference head ends remained black. The dye was identified as being a developed color. Although diazotized and developed blacks on acetate-rayon fabrics are generally sensitive to alkalis, they are fast to washing in neutral soap solution. In the case of the pieces represented by the slips submitted by the customer, it appeared that the color had not been properly diazotized and developed after dyeing, a defect for which the dyer was considered responsible.

CASE 4-28. YELLOWING OF GARMENT SECTIONS

Garments

White broadcloth shirts

Fabric Construction

Count: 112×60

Warp: $30/1$ 50% cotton

50% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon

Filling: $40/1$ Same as warp

Complaint

Sections of white shirts turned yellow after laundering.

Analysis

Analysis of the fabric in the yellowed sections showed that it was of the same composition as parts of the shirt which had remained white. Chemical tests, however, revealed the presence of melamine formaldehyde resin in the colored portions. On the tracing of a shipment of the goods to the cutter, it was learned that he had purchased an odd lot of shirtings, some pieces of which had resin finish to obtain dimensional stability in laundering. Evidently the cutter had been careless in making the garments and had used pieces from different lots of goods. When the shirts were laundered by the consumer and given a chlorine bleach, those parts of the shirts which were made from the pieces containing the resin turned yellow.

Since the manufacturer had no way of knowing how many new shirts might yellow after they were worn, laundered, and chlorine-bleached, he enlisted the aid of the laboratory to try to separate the good garments from those which he would have been obliged to sell as "seconds." Fortunately, it was found that under the ultraviolet lamp the resin-finished fabric fluoresced in a distinctive manner. This permitted rapid examination and classification without damage.

CASE 4-29. SHADE VARIATION

Garment

Man's new white sport shirt

Fabric Construction

Count: 114×52

Warp: 150/40 dull acetate rayon

Filling: 300/80 dull acetate rayon

Complaint

A shirt manufacturer complained of the fact that the fabric in the collar and cuffs appeared whiter than the balance of the shirt.

Analysis

Swatches of the fabric taken from the shirt body and parts of the collar and cuffs and inspected under the same light source showed them to be identical. Examination of the cotton liner fabric in the collar and cuffs, under the same conditions, showed it to be blue-white in color, as compared with the shirt material, which was of a more creamy-white shade. This defect was due to the use of liner fabric which was different in shade and showed through sufficiently to give the two-tone effect. It was suggested that the manufacturer select his lining material to match the shirting fabric in shade.

CASE 4-30. CREASES

Garment

Woman's suit jacket

Fabric Construction

Count: 104×74

Warp: 20/1 25% $1\frac{1}{2}$ -in. $1\frac{1}{2}$ -den. bright viscose rayon
50% 2-in. 3-den. dull viscose rayon
25% 58's wool cut 2 in.

Filling: 22/1, same blend as warp

Complaint

Irregular creases in several places, which the garment manufacturer claimed could not be removed in pressing

Analysis

It was impossible to take out the creases by any known pressing methods, wet, dry, or with a steam iron. Records indicated that the fabric in this garment had been given a resin crease-resistant finish. On removal of the urea formaldehyde resin from a cutting in the laboratory, it was found that the creases could be eliminated by ordinary hand ironing. It appeared that this defect was due to the introduction of creases in the goods just prior to the application of the resin and curing. As a result, they were permanently set or cured into the fabric as long as the resin was present.

CASE 4-31. HOLES IN SHIRT

Garment

Man's rayon sport shirt

Fabric Construction

Count: 120 × 68

Warp: 120/40 dull acetate rayon

Filling: 15/1 50% 1½-in. 1½-den. bright viscose rayon
50% 1½-in. 3-den. dull acetate rayon

Complaint

Holes developed after very few wearings and launderings.

Analysis

Inspection disclosed that the holes appeared chiefly in those areas where the fabric was doubled or in several layers, such as at the collar points, cuffs, and seams. In other sections the fabric surface had a smooth, glazed appearance. Analysis showed evidence of fusing of the acetate in those places, as if by a hot iron. It was concluded that the damage was caused by the use of excessive heat in ironing, a condition for which neither the mill nor the manufacturer could assume responsibility, because this is a characteristic of cellulose acetate fibers and yarns which is commonly known. In this particular case, too, the garment bore a label cautioning the user to "iron with a cool iron only."

Many attempts have been made to overcome the danger of fusing fabrics made of cellulose acetate rayon when they are ironed at high temperatures by means of saponification of the fabric surface. In general, this technique has not been very successful, probably because the saponification process weakens the fibers, reduces the denier, tends to cause yarn slippage, and alters the dyeing characteristics.

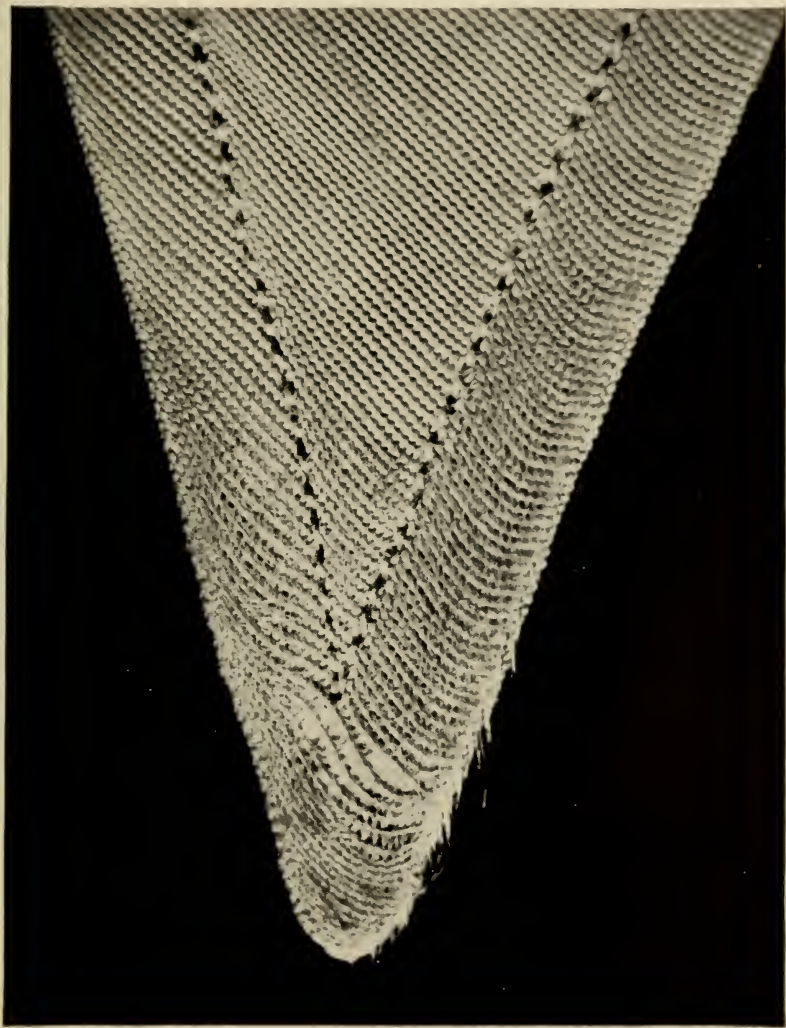


FIG. 92. Damage due to melting of acetate rayon by use of too hot an iron.

CASE 4-32. BLUE STAINS

Garment

Nurse's white uniform

Fabric Construction

Count: 162×114

Warp: 70/34/7 semidull nylon

Filling: Same as warp

Complaint

Blue discoloration appeared under the arms and around the waist after one wearing.

Analysis

From the location of the stains it appeared that they might have been caused by perspiration. It was possible to duplicate this defect in the laboratory by the application of dilute acetic or lactic acids. Investigation disclosed that the nylon yarn used in this fabric had been tinted blue by the yarn manufacturer. Although alkaline scouring by the finisher removed the color from the gray goods, it was restored when subjected to acid perspiration. When the finisher was advised of this defect, he made some plant trials and found that he was able to destroy the tint permanently by special processing. The yarn manufacturer subsequently cooperated and discontinued the use of this tint.

CASE 4-33. COLOR CHANGE

Garment

Man's end-and-end broadcloth shirt

Fabric Construction

Count: 80×72

Warp: 40/1 combed cotton, yarn dyed

Filling: Same as warp

Complaint

The customer claimed that the shirt changed color in laundering.

Analysis

Examination of the washed shirt showed that the warp arrangement was one blue-dyed end alternating with one pink-dyed end, with the filling all pink. No fabric of this color combination had been made by the mill, but samples were obtained of head ends which represented goods delivered to this customer. One was a blue-and-white combination, and the other was a helio-and-white combination. Laboratory tests were made on these cuttings for colorfastness to laundering at 180°F. with soap and soda ash and 0.01% available chlorine solution. There was no evidence of any fading, color change, or staining of the white yarns. A swatch from the washed shirt was tested under the same conditions and the pink color disappeared completely, leaving the fabric blue and white. Wash tests made at 160°F. without the use of chlorine resulted in a reduction in the depth of the pink color and staining of the white test fabric. It was concluded that the fabric in the shirt had originally been blue and white and had apparently been "topped" or tinted by the customer with a direct pink dyestuff which had poor colorfastness to laundering.

CASE 4-34. CHANGE IN SHADE

Garment

Nurse's uniform of white "Luana"-type fabric

Fabric Construction

Count: 108×48

Warp: 150/40 dull acetate rayon

Filling: 25/1 50% 1½-in. 1½-den. dull viscose rayon
50% 1½-in. 3-den. dull acetate rayon

Complaint

The customer returned the garment to the retailer because one sleeve of the uniform turned to a beige color after the first laundering.

Analysis

It was evident that the sleeve of the garment in question had come from a piece of goods representing a different finishing lot than did the goods in the remainder of the garment, since fabric constructions were identical. Chemical tests made on the beige-colored sleeve showed the presence of manganese. Apparently the finisher had used permanganate bleach on one or more pieces of this fabric in trying to obtain a good white, but had neglected to rinse the goods thoroughly, leaving a residue of colorless manganese salts. Subsequent oxidation of these compounds resulted in their changing to the brownish oxides, producing the beige discoloration. It was possible to eliminate this color by treatment with a reducing agent, such as sodium hydrosulphite solution.

CASE 4-35. TENDER SHIRTS

Garments

Yarn-dyed striped cotton-broadcloth shirts

Fabric Construction

Count: 96×60

Warp: 35/1 combed cotton, yarn dyed gray and red

Filling: 40/1 combed cotton (white)

Complaint

New shirts which, in most cases, had been laundered only once were returned with evidence of tendering of the fabric.

Analysis

Tensile-strength tests showed the goods to be tender. The fact that a great many garments of various patterns and made by different manufacturers were returned by laundries from widely scattered parts of the country precluded the possibility that faulty garment manufacture, excessive wear, or abnormal laundry practice was responsible for this defect. The shirting fabrics were all traced to one finishing plant, and it was learned that a small amount of urea formaldehyde resin had been used in finishing, presumably to aid in obtaining stabilization. If fabrics containing such resin are subjected to chlorine bleach and this is not followed by an antichlor agent, a reaction compound is formed which subsequently results in the liberation of hydrochloric acid when the goods are ironed.

Despite the fact that theoretically commercial laundries do not use chlorine bleach on colored-yarn fabrics, it was evident that such a practice was common in many laundries at the time when the complaint arose. Also, although the use of an antichlor compound, such as sodium bisulphite, would remove the chlorine, it was not usual nor was it to be expected that all laundries would use such precautions, particularly as the bleach is readily removed by rinsing fabrics which contain no resin.

CASE 4-36. DISAPPEARANCE OF PATTERN

Garment

Woman's white waffle-piqué dress

Fabric Construction

Count: 84×72

Warp: 36/1 cotton

Filling: 40/1 cotton

Complaint

Waffle pattern disappeared after laundering.

Analysis

Examination of the dress fabric and chemical tests showed that the piqué pattern was not woven but was produced by the application of a resin finish followed by the embossing of the pattern in the finishing plant. This type of finish, while it is not considered permanent, is reasonably durable to dry cleaning and washing, provided that the fabric is not ironed with too much pressure on the right side while wet. The flattening out of the fabric and disappearance of the waffle pattern in the garment returned was apparently due to lack of caution in pressing the damp fabric on the right (pattern) side. Laboratory tests made on similar fabrics at a later date indicated that the technique of applying finishes of this type had improved greatly, making them much more durable in repeated laundering and ironing.

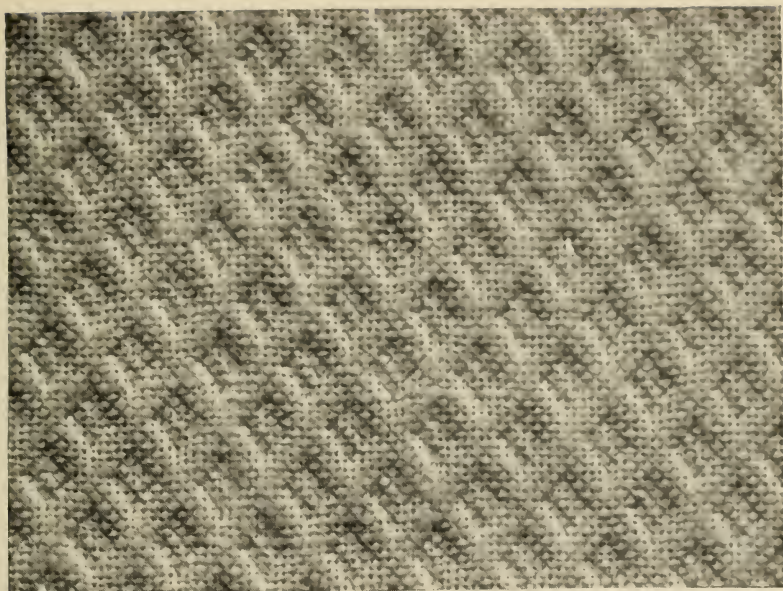


FIG. 93*a*. Original embossed waffle pattern.

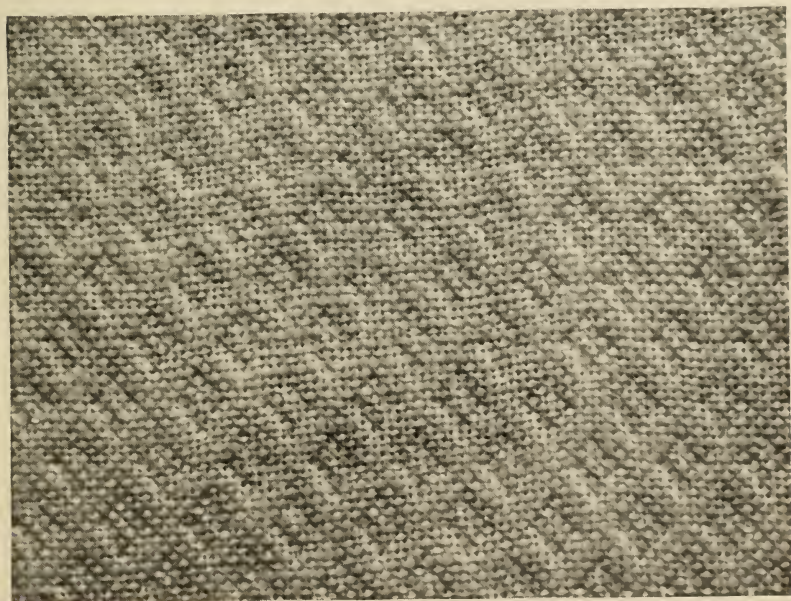


FIG. 93*b*. After washing and ironing.

CASE 4-37. COLOR CHANGE IN LAUNDERING

Garment

Man's green sport shirt

Fabric Construction

Count: 120×50

Warp: 100/40 dull viscose rayon

Filling: 22/1 spun viscose-rayon slub

Complaint

The customer claimed that the color changed from green to gray after one laundering.

Analysis

Laboratory wash tests made on a file head end from the same dye lot of goods delivered to the garment manufacturer showed no appreciable change of shade or loss of color at 100°F. in standard washing formula. It was possible to duplicate the change of color from green to gray by use of chlorine bleach. These tests indicated that the garment had been subjected to bleaching during laundering, contrary to accepted practice for colored goods. Since the fabric was not represented as having been dyed with colors guaranteed to resist chlorine bleaching, and since in the laboratory a standard rayon wash test was proved to be satisfactory, the converter felt justified in not accepting responsibility for this complaint.

CASE 4-38. WORN SLIP

Garment

Woman's white satin slip

Fabric Construction

Count: 218×90

Warp: 55/20 bright acetate rayon

Filling: 75/24 dull acetate rayon

Complaint

Slip was badly worn in front after only a few wearings and one laundering.

Analysis

Tensile-strength tests made on the warp and filling of the upper portion of the slip, where there was no sign of unusual wear, showed the fabric to be about 40% weaker than file head ends of the identical construction. In addition, breaking-strength tests were made on the shoulder straps taken from the garment, and an appreciable loss of strength was observed. (This was determined by calculating the theoretical normal strength of the original strap fabric from the construction.) Since the shoulder straps were of a different construction, not made by the weaver of the underwear fabric, it appeared that the garment had been abused in laundering, perhaps by the use of chlorine bleach. A similar deterioration was obtained in the laboratory by such treatment. The fuzzy and badly worn appearance in the lower part of the garment was to be expected, since this is the area most subjected to rubbing and wear in use.

CASE 4-39. SPOTS ON COLLARS

Garments

Fused shirt collars

Fabric Construction

Laminated, fused collars made with white cotton broadcloth and acetate-and-cotton collar lining

Complaint

A shirt manufacturer detected numerous red spots on the white shirting fabric after the collars were fused. As he had previously encountered color stains which were traced to the finisher of the broadcloth, he assumed that the red stains were of similar origin.

Analysis

Laboratory chemical tests showed that the red stains were not dyestuff. Microscopic examination proved them to be slight deposits on the outer surface of the broadcloth. It was possible to trace all the defective collars to one operator, who was performing the fusing task, and it was subsequently determined that the stains were due to red fingernail polish coming off during the application of the acetone solvent used in the lamination of the three plies of fabric.

Obviously, the origin of this defect would have been extremely difficult to determine if it had not been for the fullest cooperation of the shirt manufacturer.

CASE 4-40. WHITE SPOTS AND HOLES

Garment

Man's tan sport shirt

Fabric Construction

Count: 120 × 54

Warp: 120/40 dull acetate rayon

Filling: 18/1 50% 2-in. 3-den. dull acetate rayon
50% 2-in. 3-den. bright viscose rayon

Complaint

Very small white spots and holes were found in scattered areas throughout the shirt.

Analysis

Inspection of the garment submitted showed the presence of numerous small white specks on both sides of the fabric and a few small holes in the spotted places. Some of these specks were found on the shirt fabric under the pocket, which indicated that the damage was not produced after the shirt had been made up. Microscopic examination revealed what appeared to be small white deposits on the fabric, but ordinary laboratory soap scouring and dry cleaning did not remove them. Tensile-strength tests indicated that the yarns were tender wherever the specks were present. Although the foreign substance could not be identified, it was concluded that the defect was due to the spattering of some solvent which attacked the acetate rayon in the fabric. While this type of damage would be more likely to take place in a finishing-plant operation than in the cutter's factory, it was difficult to understand why the garment manufacturer had not noticed the defect during the laying out of the pieces, prior to cutting.

CASE 4-41. HARSHNESS OF HAND

Garments

Laundered bird's-eye diapers

Fabric Construction

Count: 64 \times 50

Warp: 29/1 carded cotton

Filling: 13/1 carded cotton

Complaint

Excessive roughing up and harshening of the hand in diapers after several launderings. The customer claimed that the cotton quality was inferior.

Analysis

Analysis of the cotton in the laundered diapers, as well as in cuttings of new diaper fabric, showed that the cotton was of standard quality and fiber length. Repeated laundering tests made on new diapers from the same delivery showed no excessive balling up or harshening of the hand. It was concluded that this defect was due to improper laundering. High alkalinity of the scouring bath, along with careless drying and processing in the laundering, is frequently responsible for an undesirable rough and harsh hand.

CASE 4-42. SPOT-CLEANING STAINS

Garments

Women's underwear (slips and gowns)

Fabric Construction

Count: 150 × 94

Warp: 75/50 bright acetate rayon

Filling: 75/30 voile-twist viscose rayon

Complaint

A garment manufacturer reported the formation of rings when soiled places were spot-cleaned.

Analysis

Laboratory tests made on the garments returned and also on file head ends showed that, if standard commercial spot-cleaning fluids were not used properly, the cleaning rings appeared. These rings were composed of concentrated residues of dyestuff and finish, which accumulated at the outer edges of the cleaned areas when the dry-cleaning solvents evaporated. However, when the proper technique was used to spot-clean soiled places with selected commercial dry-cleaning compounds which did not evaporate too readily, there was no ring formation.

Practically all rayon underwear fabrics of this type contain a small amount of finish to give the proper hand and appearance. These finishes are seldom of a permanent type and the garment manufacturer is expected to exercise reasonable care to avoid excessive oil staining during cutting and sewing, or those entrusted with the later spot cleaning should be well-trained to prevent injury to the fabric.

CASE 4-43. HARD SPOTS

Garment

Woman's dress

Fabric Construction

Count: 52×52

Warp: 100/60/50 S bright viscose, plied with 150/40 dull acetate rayon

Filling: 150/40/20 dull acetate rayon

Complaint

Hard spots in the mid-portion front of the dress

Analysis

Analysis showed that this defect was due to a partial dissolving and hardening of the acetate yarns in those spots. Although it was impossible to determine by chemical means the particular solvent which might have caused this fault, because it had completely evaporated after the damage was done, it was reasonable to believe that a few drops of nail-polish remover had been accidentally spilled on the front of the dress. Most of the commonly used nail-polish removers (and nail polishes) contain acetone or some other organic solvent which attacks cellulose acetate rayon. Since there is a definite solvent action, with permanent damage to the yarns, it is impossible to restore the fabric to its original condition. In some extreme cases, the solvent action may be great enough to cause complete removal of the acetate component of the fabric, producing holes.

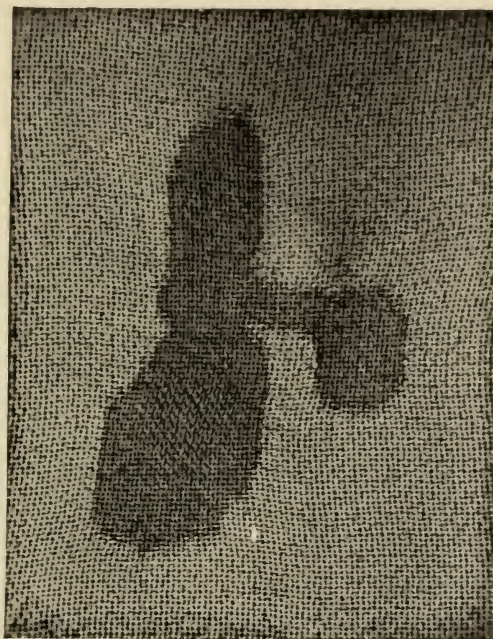


FIG. 94a. Hard stain in fabric.



FIG. 94b. Undamaged area.

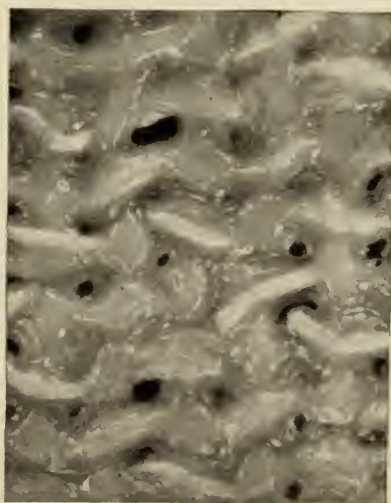


FIG. 94c. Acetate yarns dissolved.

CHAPTER 5

MISCELLANEOUS IMPERFECTIONS

This chapter is somewhat of a catchall for a few miscellaneous case histories of faults or defects which have arisen from time to time on items involving textile materials. In addition to the several items described in which a definite conclusion was reached as to the probable cause of the imperfection, it is a great temptation to describe a number of incidents in which no satisfactory explanation could be arrived at, either by the author or by numerous technical experts who were consulted when the findings did not lead to a convincing solution. However, it is believed that nothing would be accomplished by presenting the "unsolved mysteries" to be encountered in every type of business, except that their presentation would call forth a wave of suggestions that might add to the confusion.

CASE 5-1. HOLES

Complaint

A number of bellows from folding-type cameras were returned to the finishing plant by a customer who was engaged in the business of rubberizing black-dyed cotton fabric for this use. It was reported that pinholes had developed in the finished bellows, which were consequently rejected by camera manufacturers because of light leakage.

Analysis

The rubberizer claimed that the fabric, as delivered, showed no damage, but that the pinholes developed after the rubber had been applied. Tracing the records of the finisher who had dyed the fabric revealed that due warning had been given of

the proposed end use of this material. Since traces of copper act as a catalyst in causing rubber deterioration, special care had been exercised in selecting copper-free sulphur black dyes. Further investigation revealed that, through some error, the dyed fabric had been dried on copper dry cans, which contaminated it with sufficient metal to produce the damage. Although it might have been possible to treat the dyed fabric with cyanide solutions to remove the traces of copper which caused the trouble, the hazards involved in using such poisonous chemicals in the dyehouse were considered too great to warrant running the risk for the sake of avoiding the monetary loss which the dyer was forced to assume.

CASE 5-2. DETERIORATION OF NYLON HOSIERY

Complaint

During at least two periods in the last few years there were reported, in widely separated localities, instances of mysterious deterioration of women's nylon hosiery while it was being worn. According to the reports, holes and runs were developed in the stockings of scores of wearers when there was apparently no direct contact with any possible source of damage.

Analysis

Investigation disclosed the fact that there were tiny particles of soot in the damaged hose and, in many cases, traces of sulphuric acid were detected around the holes. In the particular localities where the mysterious destruction took place, it appeared that there was an abnormally high concentration of sulphur present in the atmosphere, probably from fuel-combustion products. The deposits of the soot- and sulphur-bearing materials and the subsequent formation of small amounts of sulphuric acid were considered the cause of the deterioration of the fine nylon filaments.

CASE 5-3. GRITTY-APPEARING CREPE YARNS

Complaint

Crepe twisted-rayon yarns were examined before weaving, and certain lots were found to have a rough or "gritty" appearance. It was decided that this condition should be investigated and corrected before the possibility of producing imperfect fabric should be risked.

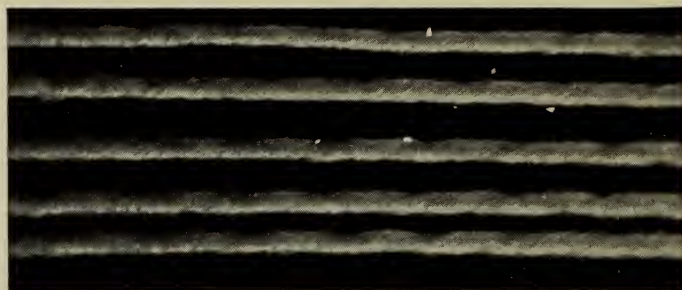


FIG. 95a. Normal crepe yarns.

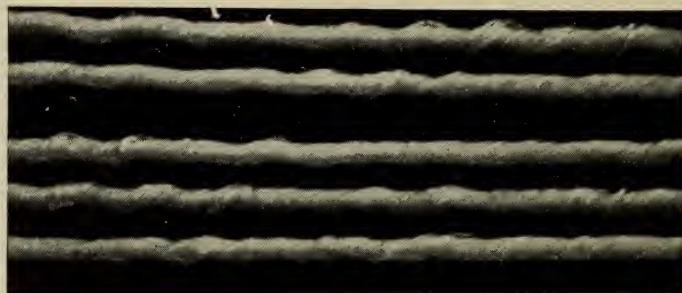


FIG. 95b. "Gritty" yarns due to faulty flyer tension.

Analysis

Analysis showed that the smooth-appearing yarns were normal production from a twister operating under relatively high tension. The "gritty" yarn was produced by a defective flyer in the twister, the bent arms apparently reducing the tension to a subnormal level. On immersion of the two yarns in water,

it was found that the normal yarn was much less active than the "gritty" yarn, being slower to untwist and open. Also, single-strand tensile-strength tests showed that the normal yarn had about 23% elongation at the breaking load, whereas the "gritty" yarn had only 18% elongation at the break. A few yards of fabric were woven with this "gritty" yarn in the filling and, after it had been boiled off and dyed, the fabric was found to present a "cracky," uneven finished appearance.

CASE 5-4. SPOTS IN BROADCLOTH SHIRTS

Complaint

A shirt manufacturer returned several new white broadcloth shirts to the converter, calling attention to the fact that the fabric showed rings when manufacturing soil and stains were spot-cleaned with standard-type, organic-solvent cleaning solutions. It is fairly common practice for manufacturers to remove machine oil and dirt stains from new garments which may have become soiled while they were being cut and sewed.

Analysis

Examination of the shirts indicated that the spots were due to faint blue "rings" which had formed around the cleaned areas. Although it appeared that these rings were caused by the migration of a small amount of blue coloring material which had been used to provide a "blue-white" finish in the broadcloth, it was not possible to reproduce the effect in the laboratory. This led to the conclusion that the shirt manufacturer had been careless in his application of the cleaning solution, or that the solution itself had become contaminated with small amounts of accumulated blue coloring from repeated use on similar white fabrics.

CASE 5-5. FABRIC FUSED IN CUTTING

Complaint

A manufacturer of men's clothing returned cellulose acetate lining fabrics to the converter, claiming that the goods were defective because the edges became stuck together when a number of layers of fabric were being cut for suit linings.

Analysis

Physical and chemical tests proved that the fabric and finish in the lining materials returned were normal in all respects. Apparently the garment manufacturer was not familiar with the characteristic low melting temperature of cellulose acetate materials and had allowed his cutting blade to get too hot, fusing the edges of the cut pieces. This condition can usually be corrected by not attempting to cut too large a lay of fabrics or by applying a small amount of paraffin to the cutting blade as a lubricant.

CASE 5-6. WARP STREAKS

Complaint

Women's all-wool dress goods, dyed dark red, showed short, light streaks in the warp and the filling.

Analysis

Microscopic examination revealed that the light streaks were due to the presence of single wool fibers which apparently did not take on the dyestuff. It was impossible to eliminate this condition by any known dyeing procedure. When the single fibers were studied more closely, it was evident that they were in a damaged condition. Although the exact cause of the damage to the fibers in the finished fabric was not determined, it was assumed that a small amount of one lot of wool had suffered mildew or bacteria attack, which made the fibers resistant to normally applied wool dyestuffs.

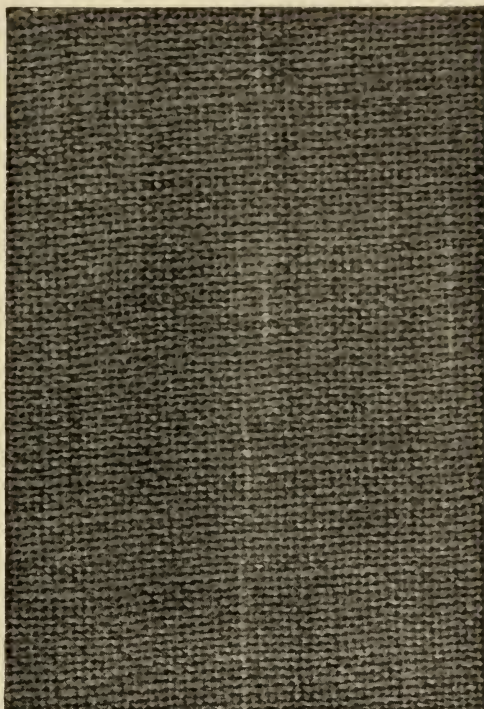


FIG. 96a. Streaks due to undyed wool fibers.



FIG. 96b. Damaged wool fibers.

CASE 5-7. SKIN IRRITATION FROM HOSIERY AND OTHER APPAREL

Complaint

In the early days of women's nylon hosiery, widespread attention was given to several reports claiming that nylon hosiery was responsible for an outbreak of rashes or skin irritation on the wearers' legs.

Analysis

Impartial investigators learned that the reports were correct and that many wearers were suffering from dermatitis traced to nylon hosiery, but analysis proved conclusively that the nylon itself was not at fault. A rosin finish applied by several dyers to enhance the appearance of the stockings and, at the same time, reduce snagging contained adiepic acid, which is a skin irritant. With the elimination of this finish, all complaints of this nature ceased. At about the same time, there were cases reported of severe dermatitis resulting from a similar finish applied to cotton woven fabrics used for men's shorts. Textile finishers and the manufacturers of chemical materials used as finishes now make certain that any new products developed for application to textile materials which may come in contact with the wearer's skin are thoroughly tested for possible danger of causing such skin irritations.

Dermatitis is not uncommon among industrial workers and general consumers. Instances are frequently reported of people who develop skin irritations when handling or wearing fabrics composed of certain fibers. Although some chemicals may be responsible for specific conditions, there is no way of guaranteeing absolute immunity to every individual. There are standard, accepted procedures whereby products are tested on large groups of individuals, and it must naturally be assumed that, where the incidence of the development of a skin irritation is of a very low order, those materials may be classed as harmless. There is no reason why the manufacturer of such products which

come in contact with the skin can be held responsible for the peculiar allergies of a few individuals in the population, any more than a fruit or a vegetable dealer can be considered responsible for the sale of foodstuffs which "disagree" with certain consumers.

CHAPTER 6

THE INVESTIGATION OF FABRIC DEFECTS

Personnel Training and Experience

Even the most skilled textile technician or experienced trouble shooter cannot hope to be able to do a thorough and efficient job without adequate facilities and working tools. On the other hand, the finest laboratory instruments alone are useless in the hands of an inexperienced technician. To be truly competent in the art of determining the cause of defects in woven fabrics composed of cotton, rayon, and wool, and in constructions ranging from the simple, plain-weave sheetings to the intricate spun-rayon blends and novelty combination-yarn crepes, one should have a good working knowledge of every phase of manufacturing, from raw fiber to woven fabric, as well as training and experience in all aspects of the finishing of such fabrics, including boil-off procedures, bleaching, dyeing, printing, and finishing. Then, finally to execute analysis of the probable cause of fabric faults, one should be trained and experienced in fiber and fabric analysis, encompassing schooling in textile microscopy, fiber and yarn characteristics, all phases of physical testing, and the fundamentals of textile chemistry. With this background, the expert will be fortunate if he is gifted with an inborn talent for detective work, endowed with a fair amount of good common sense, favored with a moderate degree of honesty to be able to admit not knowing the answer when such is the case, and blessed with a sense of humor to give him strength to tackle another "impossible" job.

In some large laboratories it is not unusual to utilize a team of workers for such defect analysis—a fabric technician with no knowledge of microscopy, a microscopist with no knowledge of fabric manufacture, a chemist with no knowledge of weaving, and so on, each working on a clue in the picture puzzle under

the direction of one who, by experience and training, is able to put the pieces together and arrive at a logical solution. While this may be satisfactory in many instances and, in fact, quite necessary, since there are not too many technologists with experience and training in all the above-mentioned fields, it is important that each worker try to acquire knowledge and experience in the other branches of the field if he is to be of maximum service and if he hopes to develop into an efficient aide.

Facilities and Equipment

It is not proposed to present a complete manual on the ideally conceived and equipped laboratory, along with detailed procedures for making physical and chemical tests. There are available a number of well-written texts on these subjects, as well as handbooks of standard procedures adopted and recommended by such organizations as the American Society for Testing Materials, Committee D-13 on Textiles, and the American Association of Textile Chemists and Colorists. There are, also, government publications, such as Commercial Standards CS-59 and CCC-T-191a, which describe methods to be used for specific tests.

The following is a concise review of the principal facilities which have been found most useful in making analyses of most of the fabric defects described. It is suggested that an effort be made to provide for or to have available as much of this equipment as possible. It is, of course, quite possible to track down many fabric imperfections with as few tools as an ordinary pick glass, as little training as a superficial knowledge of fabric inspection and grading, and much imagination; but a "detective" of this kind is hardly likely to earn his degree as a master sleuth when he encounters something more than a variation in pick count, an oily slub, or a dye streak.

Standard Conditioned Atmosphere. Because the moisture content of textile fibers, yarns, and fabrics has a marked influence on their physical properties—such as tensile strength, elongation, and weight, in particular—it is considered important that provisions be made for a room in which the temperature and relative humidity can be maintained at the accepted standard at-

mospheric conditions of $65 \pm 2\%$ relative humidity and $70 \pm 2^\circ\text{F}$. While it is true that in a great many cases the determination of comparative strengths of yarn or fabric weights is adequate for arriving at the solution to a particular defect, sooner or later one finds it necessary to make absolute and reliable determinations, and tests made on fabrics which have standard regain are a definite requirement, particularly if the test results are likely to be disputed. By way of warning, attention is called to the fact that the construction and maintenance of a laboratory room with these rigidly controlled conditions is not a job for an amateur carpenter or a pseudo engineer. The size and location of the room, the number of motor-driven machines, the lights, the operators in the room, the air circulation, and possible extremes of outside atmospheric conditions are but a few of the factors which have a decided influence on exact and consistent operating conditions. It is wise and economical to depend upon only experienced and reliable engineers to design and install the necessary equipment, for the sake of saving time, tempers, and shutdowns at a later date. It has been the writer's experience that there have been more inadequately engineered so-called "conditioning rooms" installed than there have been well-designed and perfectly operating ones. It is seldom that a "comfort"-unit air-conditioning system, made specifically to control relative humidities and temperatures within the comparatively wide ranges suitable for home-dwelling or office-working conditions, is capable of giving consistently good results and of maintaining the narrow limits of the above-mentioned specified "standard" conditions demanded by a testing laboratory. As many mills and technicians have learned from experience, such makeshift installations represent poor economy.

Physical Testing Machines and Instruments. Perhaps the simplest tools with which every textile technician is always equipped are an accurate pick glass of good quality—preferably one with a 1-inch-square field—a pick needle, a pair of scissors, a ruler marked off in inches and centimeters, and a direct-reading yarn balance. The importance of a good-quality, accurate pick glass is emphasized, because the writer has actually had experience with the simple matter of a dispute on the pick count of

some gray goods. Investigation showed that the customer who was registering the complaint was using a foreign-made pick glass of inferior quality, with an "inch" opening which actually measured only $1\frac{5}{16}$ in. In this particular case, the result was an apparent pick-count reading of only 60, instead of 64, picks per inch.

The few pieces of equipment listed above permit the determination of thread count, weave, and yarn size—all truly fundamental in fabric analysis. In place of the more costly, though easier to use, direct-reading Universal yarn balance, some technicians still use the old-type, pocket-size, beam balance, whereby yarn counts are determined by the number of evenly cut prefixed lengths of yarn which counterbalance a small weight. For longer lengths of yarn it is possible also to use grain scales or an analytical balance after first measuring the yarn on a hand-operated yarn reel.

A twist tester is another essential piece of equipment, whether it be of the simple, hand-operated type, with rotating dial recorder, or the automatic hand-driven or electrically driven model, with attached counter. For determining cloth weights one can rely on the accurate cutting out of any size of sample and weighing on an analytical balance and calculating the weight in ounces per square yard. More efficiency is obtained if one uses 4- by 4-inch or other conveniently cut samples, employing special dies and a chopping block, or the disk-type cutter, which punches out swatches of about 3 square inches in area. The latter type of punch is particularly easy to use, and rapid weight determinations may be made by placing the exactly cut specimen on a quadrant-type, direct-reading balance which gives weight in ounces per square yard directly.

Fabric tensile-strength and elongation tests require cloth-testing machines of adequate capacity, preferably those equipped with autographic recorders, to indicate the elongation at various loads, as well as to record the ultimate breaking strength and elongation. For single yarn tests, a vertical or a constant-rate-of-loading, incline-plane type of testing machine is a valuable piece of equipment, particularly if one is attempting to determine the stress-strain characteristics of single yarns removed

from fabrics or to determine whether or not a rayon yarn is of regular, medium, or high tenacity. Spool attachments for the standard type of breaking-strength machines permit the testing of yarn-skein strengths, the skeins being first prepared on reels of $1\frac{1}{2}$ yards circumference. Fiber tests may be made on a specially designed Pressley tester, or by the standard flat-bundle test on the conventional fabric-testing machine, with little auxiliary equipment for paralleling the fibers; but this type of test is not needed very often in fabric-defect analysis.

Seam-slippage determinations are frequently necessary in determining whether or not a woven fabric meets specifications or is likely to cause trouble, and an inexpensive, standard home-type sewing machine is adequate for such work. The same sewing machine may be used to ascertain whether or not certain constructions or finishes tend to cause needle cutting during normal sewing operations.

Laboratory abrasion testing on woven fabrics can be very misleading if one is attempting to evaluate the probable durability of yarns or fabrics in service. In general, many technicians who are well versed in the complicated problems involved in making such tests and attempting to interpret the results believe that, unless one is concerned with problems pertaining to fundamental research investigations, it would be best not to have any type of so-called "wear-testing" machine in a textile-testing laboratory. On the other hand, it is true that there are certain specific instances in which an intelligent and experienced technician can make some use of data obtained on such an instrument, particularly when there is available experience gained from fabrics which have shown success or failure in garments in actual service.

For examining yarn for uniformity, before it is woven or after it has been removed from a piece of fabric, a small, hand-operated yarn-evenness tester which permits the laying of a number of ends adjacent to one another at regularly spaced intervals on a small blackboard can be very useful. In the mills, the more elaborate motor-driven Seriplane, with accommodations for a series of larger boards, is commonly used. More recently, electrical instruments have been developed for measuring and

recording yarn uniformity, the yarn passing at high speeds through a photoelectric scanning device or between two electrodes which measure and record variations in bulk density by differences in electrical capacitance or by some other similar means.

At times when the question of the evaluation of water-repellent finishes is involved, it may be helpful to have in the laboratory the simple, inexpensive A.A.T.C.C. Spray Tester. More elaborate and expensive machines for determining the degree of water repellency of textile materials are the A.A.T.C.C. hydrostatic pressure tester and the Rain Tester, but such instruments are not truly essential for the investigation of fabric defects.

Colorfastness and Fabric Shrinkage. At times it becomes important to check on the colorfast properties or the shrinkage characteristics of dyed and finished fabrics. To do a thorough job requires such standard pieces of equipment as a Launder-Ometer for evaluating colorfastness to washing, a Fade-Ometer for determining fastness to sunlight, a Crockmeter for gauging resistance to dry and wet crocking, and a suitable gas chamber for ascertaining the fastness of certain dyes on acetate rayon to atmospheric gas fading. Standard tests for colorfastness to perspiration require comparatively simple and inexpensive equipment, to be found in any chemical laboratory. To be sure of proper lighting for the study of color change after some of these tests, it is advisable to have a good source of north light or, better, artificial lighting equipment recognized as standard for making such color comparisons.

Fabric-shrinkage complaints call for facilities for making the standard wash tests of fabrics, such as a reversing-type wash wheel, a flat-bed press, and a hand iron. Occasionally, it is necessary to investigate the effect of steam pressing, and a flat-bed press equipped with a live-steam bottom buck is most useful, with an ordinary hand steam iron as second choice. For determining colorfastness or shrinkage in dry cleaning, the Launder-Ometer or a small dry-cleaning tumbler is usually prescribed.

Microscopic Facilities. Some type of microscope is a "must" in any textile laboratory in which one is concerned with the analysis of yarn or fabric defects. While in many cases a great

deal can be learned by careful visual inspection without the aid of optical equipment, or with a pick glass and a burning match, in most instances a leisurely examination at a moderate magnification or a study of fibers in longitudinal or cross section at fairly high magnifications is necessary. In the study of rayons, microscopic examination of filament cross sections is absolutely essential when one considers the importance of recognizing such variables as filament size and contour, or as the quantity and distribution of pigment delustrants. Other simple applications for which a microscope is indispensable are the study of cotton fibers for the degree of mercerization; the identification of many of the animal-hair fibers; the examination of all types of fibers for mildew, bacteria, or insect damage; and the identification of many starches or other warp-sizing or finishing materials. It may also prove to be an invaluable aid in the determination of the penetration of certain dyes or finishes.

In addition to its value for the measurement of man-made fiber deniers, the microscope is generally considered the best means for making measurements of wool-fiber diameters, in order to determine quantitatively the grade of wool in a specimen. Not infrequently it is necessary to determine the twist in yarn available only in such small lengths that it is impossible to use a twist tester, or in fabrics which may not be destroyed by removal of the yarns in question. In these instances one can calculate the turns per inch by microscopic measurement of the yarn diameter and the twist angle. In Schreiner-calender-finished fabrics, the microscope can be relied upon to determine the exact number of engraved lines per inch, their angle, and in some cases the depth and contour of the engraving.

For the study of simple defects or fabric weaves, a stereoscopic binocular microscope is practically indispensable. It affords magnifications up to 150 diameters, a good depth of focus, and sufficient working distance between the objectives and the sample for easy manipulation. Work requiring magnifications up to 1,000 or critical study of fiber surface or cross-section details calls for the use of a compound microscope of the chemical type. While not absolutely essential, it is nevertheless desirable to have a built-in mechanical stage and/or a rotating

stage, with a substage condenser for better transmission and focusing of light.

For critical study of unusual conditions in yarns and fibers, it cannot be overemphasized that the user of a microscope should be a skilled technician, because it is not unusual for one who is incompetent to see and report nonexistent phenomena. For the examination of fiber or yarn cross sections, a simple metal plate drilled with holes of about 0.035 inch diameter serves admirably, but for the study of dull-luster rayons and many of the natural fibers it is necessary to use extremely thin-cut sections prepared by means of a rapid cross-sectioning plate, Schwarz or Hardy type, or the more elaborate microtome. Such accessories as glass slides, cover glasses, razor-blade holder, stage micrometer, immersion liquids and stains, and good lighting facilities—including high-intensity lamps—are, of course, needed to make possible the full use of the microscope. A camera lucida will be found to be of great help in drawing pictures of fiber, yarn, or fabric—particularly for making sketches for measurements or record—when expensive camera equipment is not available. If polarizer-analyzer equipment is included in the list of accessories provided, a competent microscopist can also learn much from the examination of man-made fibers in polarized light. At the same time, it is a good idea to have available a complete library collection of all types of fibers in the yarns or fabrics which the analyst is likely to encounter. These can be used as standards for reference in the study of surface and cross-section characteristics, as well as for their reaction to stains and other chemicals.

Darkroom. Although a darkroom with projection equipment for both transmitted and reflected light is not absolutely required, it will be found very helpful in cases in which it is desirable to demonstrate certain fabric structures or imperfections to a group of several people at the same time. What is probably first considered in setting up a darkroom is adequate camera equipment for taking photographs and photomicrographs of textile materials. Most of the case histories herein described are illustrated with such photographs, which are very effective when the technician is anxious to present an actual picture of what he has seen

through the microscope. Projection equipment is also used with the microscope (microprojector) in measuring fiber diameters or cross-sectional areas, as well as for identification purposes. If one wishes to have a more complete photographic darkroom, an added luxury is an enlarger to prepare enlarged views of selected portions of a photograph or a photomicrograph.

A tool which is comparatively inexpensive, considering the many uses to which it may be put, is a good source of ultraviolet light. This should be kept and used in the darkroom, if one is available, or it may be employed in any room if a small area is curtained off for full effectiveness in examining materials under this light source. While the proper use of such light has been the subject of a number of authoritative publications, it may be said, in brief, that its greatest value lies in the fact that certain materials fluoresce characteristically under ultraviolet light, and the lamp provides a simple, rapid method of identifying the presence or absence of certain substances, with no damaging of the specimen which is being studied. For example, once the operator has acquired the proper technique and experience, it is possible to detect the presence of mineral oils, degraded cellulose, resins, starches, certain dyestuffs, and numerous chemicals.

Chemical Testing. The minimum essentials for the chemical work which may be encountered are a supply of running water and a sink, a simple drying oven, gas or electric burners, an electric flatiron, extraction apparatus, the common chemical reagents, and a full complement of glassware—such as test tubes, beakers, casseroles, pipettes, and burettes—for carrying out most of the simple chemical tests. Such tests may include the determination of moisture content, qualitative and quantitative fiber composition, gray-goods warp sizing or finishing agents, and identification of dyestuffs. One analytical balance in the laboratory will serve for both physical and chemical analyses.

In addition to the standard acid and alkali solutions and chemical-indicator solutions, the chemical reagents which will be found most useful are a good range of organic solvents, such as acetone, ethyl and methyl alcohol, ether, chloroform, carbon tetrachloride, benzene, and all chemicals commonly listed under

standard chemical analytical-test procedures. For determining chemical damage to cellulosic materials, it is often desirable to measure the fluidity of cellulose by cuprammonium or cupriethylene diamine solutions.

Boil-off and Dyeing Equipment. Facilities should be available for laboratory desizing of gray goods, boil-off and dyeing of at least $\frac{1}{2}$ -yard cuttings of full width. These operations may be carried out in large pots or pails, or in flat vessels which permit the handling of flat goods, such as satins or taffetas, which should not be subjected to creasing while wet; or they may be performed in laboratory-scale, specially constructed dye boxes, preferably of the enclosed type, with means for keeping the sample in motion and controlling the dye-bath temperature. For drying wet-processed samples, a simple curtain stretcher may be used, with electric fans for drying; or more elaborate laboratory driers may be constructed, with means of supplying heat uniformly to both sides of the sample at once, in order to prevent color migration through one-sided drying.

The laboratory should have on hand an adequate supply of desizing agents, detergents, dyeing assistants, and dyestuffs for the application of color to all types of fibers. Particular effort should be made to employ compounds which are normally used in commercial practice, especially if one is attempting to simulate a normal dyeing or finishing process. In the selection of dyestuffs, for example, care must be taken to consider the specific requirements in the dyed sample submitted for investigation, with special attention to such matters as colorfastness to light or to washing. In the case of the investigation of the nonlevel dyeing of certain rayon fabrics, it is possible to select dyestuffs which are particularly good for level dyeing but which could not be used commercially because of their lack of certain fastness requirements which the converter has specified.

The above equipment will enable a good technician to perform practically all of the tests necessary for doing a good job of defect analysis. It is to be noted that this brief listing does not describe the many specialized pieces of equipment which offer refinements and means of confirming many findings in conducting more fundamental research investigations. These include

such items as special substage illuminators for the microscope; single-fiber testers; and instruments for measuring fiber or yarn torsional characteristics, frictional resistance, and compressibility; a spectrophotometer for color analysis, a pH meter, a semiautomatic moisture tester, and others.

New analytical methods and laboratory equipment are being constantly developed to make the technician's task a simpler one, and the expert must keep in constant touch with such developments through close association with technical organizations and all technical publications in the field of textile testing and research.

Inadequate Samples

The greatest handicaps which confront an investigator are the inadequate size of the sample submitted for analysis and incomplete data accompanying the complaint. It seems appropriate, therefore, to close with a verse which was written by the author and which first appeared in *Textile World* in August, 1937.

MIDSUMMER MADNESS

(A Psychopathic Analysis)

by Jay B. Goldberg

MEMO from the SELLING DEPARTMENT to the MILL

* Attached please find,
Beneath the clip,
A swatch of fabric —
Just an eighth-inch strip.

* Rush analysis
By wire or phone —
The fate of our mill
Rests on this alone!

* Be sure to include
Complete construction,
But RETURN THE SAMPLE
WITHOUT DESTRUCTION!

* Tell us the count,
And tell us the weight,
Give all the facts
And get them straight!

* What are the yarns,
The make and price?
Percentage of wool,
Please check this twice!

* Now what's the dyestuff?
And what's the strength?
And what's the thickness?
And what's the length?

* And what's the cost?
And what's the sell?
And what's the profit,
If all goes well?

* We must know now,
Everything, in fact, —
But be SURE the sample
Is kept INTACT!

MEMO from the MILL to the SELLING DEPARTMENT

* Now here's the count —
Forty-one, fifty-eight;
Forty inches the width,
Three fifty the weight.

* The yarns are twentys,
Rayon staple and wool,
Dyed with fast colors
And finished quite full.

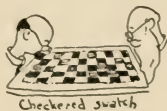
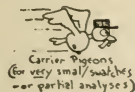
* The dyers in Jersey,
The gray mill's in Mass.,
The weaver, a cute
Little red-headed lass.

* The pulp for the rayon
Came from trees in Maine,
That were cut to the ground
By a man named Dayne.

* The wool in the yarn —
Eight percent the amount —
Came from a black sheep
That was no account.

* The sample you clipped
From a young woman's coat,
While taking her out
In your twenty-foot boat.

* From the size of the swatch
That's all we can tell,
But if you don't like it,
You can — still go and SELL!



H. B. RANE

GLOSSARY

To afford better understanding of some of the terms used in the text, but with no intention of presenting precise dictionary definitions, the following brief descriptions are given of those words and phrases which appear most frequently.

Acetate Rayon and Estron

The terms "acetate rayon" and "acetate" have been generally used by the trade to describe textile fibers made of acetic acid esters of cellulose, distinguishing them from the regenerated cellulose types commonly known as "viscose" and "cuprammonium" rayons. The American Society for Testing Materials has retained in the tentative category the term "estron" to describe all textile fibers made of esters of cellulose (such as cellulose acetate) to distinguish them from the other types of man-made fibers. Since the term "estron" has not been accepted to any great extent by yarn producers, weavers, finishers, and converters, the better known terms of "cellulose acetate rayon" or "acetate" are used in this text.

Bow

The deviation of filling yarn as it lies in a fabric from exact straight-line or right-angle relationship to the warp yarns, producing a distorted or bowed effect from selvage to selvage.

Box Loom

A loom equipped with mechanism to permit the use of two or more shuttles, making possible the production of bars, checks, or other repeating-pattern effects in the filling direction of woven fabric.

Calender

A system of rollers, usually heated and varying in composition, through which fabric is passed to obtain a particular kind of finish.

Conditioning

The process by which the moisture content of a textile material is brought to moisture equilibrium by exposure to specific atmospheric conditions of temperature and relative humidity.

Converter

An individual or concern engaged in the purchase of cotton or rayon gray goods for subsequent sale in the finished (dyed or printed) state.

Count

In woven cloth, the number of ends and picks per inch, as, for example, "92 \times 68," meaning 92 warp yarns per inch and 68 filling yarns per inch.

In spun yarns, "count" is used synonymously with the term "size" and is based on the weight of the yarn for a specified length.

Cover

The "full" even appearance of woven goods when the warp and filling yarns are uniformly well distributed.

Crimp

In fibers, the natural or artificially introduced waviness. In yarns, the difference in the length of yarn as it lies in the fabric and its length when it is straightened out but not stretched, usually expressed as a percentage of the length in the fabric.

Crocking

The transfer of color from a dyed or a printed piece of goods to another piece of fabric when it is rubbed against it.

Cross-dyed

The dyeing of two or more dissimilar fibers with different dye-stuff affinity to different shades in the same piece of fabric.

Cut Mark

A mark stamped near the selvage of a warp during slashing to indicate a definite length or to separate one piece or "cut" of cloth from the next.

Day-and-Night Mark

A mark stamped on gray goods during weaving to show change of weaver from one shift to the next—sometimes referred to as a “shift mark” and often taking the form of a symbol such as D/N.

Denier

In yarns, the measure of the yarn count as applied to continuous-filament rayon or silk, the numerical value being the weight in grams of 9,000 meters. This term is also used as a measure of the size of the individual filaments in continuous-filament yarns or in rayon staple.

Desizing

The process whereby the warp sizing of gray goods is removed, usually by use of an enzyme.

Discharge Printing

A type of printing in which the fabric is first dyed and is then printed with a paste which contains material to destroy or “discharge” the original dyed color. When the discharged area is to be replaced with another color, instead of being left white, the paste also contains the new color, which is unaffected by the discharge agent and which is applied at the same time.

Doctor Streaks

Streaks on printed cloth caused by some damage or deficient operation of the doctor blade, which is a metal scraper on a print machine supposed to remove excess color from the engraved print roll before it contacts the cloth.

Dye Box or Beck (Winch)

A dyeing machine in which fabric is processed in strand or “rope” form and which consists essentially of a large, open vat through which the cloth passes repeatedly while traveling over a large reel mounted above the vat. Dye boxes may also be of the totally enclosed type.

Dye Index

An expression commonly used in the rayon industry to rate relative dyestuff absorption or dyeing rate of rayon yarns. For example, a fiber or yarn which dyes more rapidly or absorbs more dyestuff than another yarn in the same dye bath is said to have a higher "dye index."

Embossing

The impressing of a pattern on a fabric by subjecting it to the pressure of an engraved roll.

Ends

Yarns running in the warpwise direction, or "warp threads."

Filaments

The individual fibers comprising a silk or man-made fiber yarn.

Filling Bands

Solid sections of filling yarn, generally at least several inches in width with a different appearance in shade or luster or exhibiting some other characteristic which makes them distinguishable from adjacent normal sections of filling. They may be composed of one or more complete filling bobbins of yarn, or they may show changes at knots within the same filling package.

Filling Barré

A series or cluster of streaks running in the filling direction but interspersed with sections of normal-appearing filling yarns. This condition may run from one selvage to the other, or it may be irregular in length and extend only partway across the warp.

Filling Changes

Generally similar in appearance to "filling bands," except that the change is noted at a knot or a filling-bobbin transfer, but it gradually fades or disappears at some indeterminate position so that the defect is visible only at the change.

Float

That part of a warp or filling yarn in a fabric that is unbound by the yarns in the opposite direction as specified by the weave. (In some weaves, of course, floats may be an integral part of the pattern.)

Fly

Short fibers which generally float in the air in a spinning or weaving mill and which may come to rest and be deposited on yarns or fabric during the process of manufacture.

Fray

The slipping or shifting of one set of yarns over the other in woven goods or at cut or unfinished edges.

Fulling (Milling)

A wool-fabric finishing operation which causes the felting of the wool fibers and shrinkage in length and width, producing a full, compact texture.

Gas Fading

The change of shade in fabrics containing cellulose acetate fibers and dyed with certain colors, when the fabrics are exposed to some atmospheric gases. Generally the change is from blue or shades containing a blue component to reddish hues.

Gouts

Similar in appearance to "neps," but generally confined to somewhat larger bunches of foreign matter or of waste woven into the fabric.

Gray Goods

Fabrics in the off-loom state, prior to their receiving any desizing, boil-off, or bleaching treatment.

Head End

Theoretically, the start of a piece of fabric, but more commonly used to describe a small full-width sample of gray or finished goods.

Jig (Jigger)

A dyeing machine used for processing goods in the open width and consisting essentially of a vessel holding the dye liquor and one roll mounted at either end and above the bath on which the cloth is unwound and wound, passing through the liquor during repeated operation. Each complete transfer from one roll to the other is known to the dyer as an "end."

Kinky Yarn

Yarn which loops back on itself, forming small kinks.

Moisture versus Regain

As applied to textiles, "moisture" is the total weight of water present in a material, calculated on the weight of the conditioned sample. "Regain" is the total weight of water present, calculated on a moisture-free or dry basis.

Motes

Small particles of cotton seed or other parts of the cotton plant or hulls.

Napping

A mechanical finishing process which raises the surface fibers on fabrics by subjecting them to a rotating cylinder covered with a fine wire or some other form of abrading surface.

Neps

Small bunches of tangled fibers generally observed in cotton yarns and attributed to poor cleaning or carding, or to the presence of immature cotton fibers.

Oxycellulose

Degraded cellulose products formed by the oxidation of the cellulose as the result of attack by chemical oxidizing agents.

Pad (Padder)

A dyeing machine consisting essentially of a shallow trough and a pair of squeeze rolls, between which the fabric passes and

becomes impregnated with the dyestuff or other processing solution which is being applied.

Photomicrographs and Microphotographs

These terms are frequently misused and interchanged indiscriminately. As applied to textile microscopy in particular, the correct word is "photomicrograph." It refers to enlarged photographs, very often taken through a system of lenses or through a microscope, to give a magnified view of a small area. A "microphotograph," on the other hand, is a microscopically *small* photograph and would usually serve no purpose in preparing a report on the investigation of fiber or fabric faults.

Picks

Yarns running in the fillingwise direction, or "filling threads." (Older terms are "weft" and "woof.")

Polarized Light

Ordinary light which is resolved by some means, so that it vibrates in two directions at right angles to each other. By using a material which has the ability to bring about this division, or "polarization," as an attachment to a microscope, it is possible to employ polarized light to identify, as well as to obtain valuable information about, many textile fibers. For example, it is used in many laboratories to determine the degree of cotton-fiber maturity or to detect abnormal strains in man-made fibers.

Quilling

The operation of winding yarn on filling bobbins, preparatory to their going to the loom shuttle.

Race Plate

The flat part of the loom lay in front of the reed and along which the shuttle moves.

Rayon

The generic term applied to filaments made from modified cellulose solutions by extrusion through orifices.

Resins

High-molecular-weight organic compounds, usually divided into the "thermoplastic" types, which soften on the application of heat, and the "thermosetting" types, which form permanently hard materials that do not soften on reheating. The former are familiar in the textile industry, by virtue of their use in obtaining special finishes and in manufacturing such fibers as Vinyon, polystyrene, nylon, or Orlon. The latter—particularly the urea and melamine formaldehyde types—are perhaps best known for their application in effecting stabilization and crease resistance in woven fabrics.

S and Z Twist

These terms are in general usage to designate the twist direction in single or plied yarns. In S-twist yarns, the angle of twist when viewing the yarn in a vertical position runs from top left to bottom right, resembling the diagonal of the letter S. In Z-twist yarns, the angle of twist runs from top right to bottom left, resembling the diagonal of the letter Z.

Sand Roll (Take-up Roll)

A roll at the front of a loom which is generally covered with some rough material (crepe rubber, sandpaper, cork, etc.) and which grips the cloth roll during weaving.

Saponification

The chemical process by which cellulose acetate rayon is partially or completely converted to regenerated cellulose by a splitting off of the acid acetyl groups (acetic acid). This is usually accomplished by treatment with alkaline solutions at elevated temperatures. Saponification, it should be noted, results in a loss in weight and tensile strength of the original acetate rayon. It makes possible the dyeing or printing of the fabric with the direct-type dyestuffs normally used on viscose-rayon or cotton fabrics. It is not uncommon practice to partially saponify cellulose acetate rayon materials to permit the application of such dyestuffs or in preparation for discharge print-

ing, particularly when the fabric contains a blend of viscose- and acetate-type rayons.

Schreiner Calender

A type of calender in which the heated rolls through which a fabric passes to produce a characteristic surface finish are engraved with fine lines of predetermined number per inch, angle, and depth.

Selvage

The warp yarns woven at the extreme edges of a piece of fabric, generally in greater density (yarns per inch) or differing from the remainder of the warp in composition, twist, or ply, to provide the greater strength needed for support in weaving.

Set Marks (Start-ups)

Narrow fillingwise bands where there are more than the normal number of picks per inch.

Shiners

Filling rayon yarn that appears to be abnormally lustrous, owing to its being under excessive tension, which results in a smoother surface than normal and a reduction in crimp, all of which produce greater light reflection and give a shiny appearance.

Slasher

The machine used in a weaving mill for "slashing," or the application of sizing mixture to the warp yarn prior to weaving.

Sley

The number of warp ends per inch in a cloth.

Slough-off

The act of a yarn loosely slipping off a filling bobbin or other package before or during weaving.

Slubs

Thick places in spun yarns.

Spinning

In the manufacture of yarns composed of natural fibers or of cut man-made fibers, the process whereby these fibers are converted to a finished yarn from some intermediate process in which they are first cleaned and aligned.

In the production of man-made fibers and yarns, this term is used to describe the process whereby the fiber-forming solutions are extruded through small holes to produce the individual filaments.

Spot Washing

The term used to describe an operation performed at the weaving mill on some types of gray goods, to clean badly soiled places in the fabric before it is shipped to the dyer and finisher, or to make easier their removal in normal wet processing. Any number of cleaning solutions may be used, some containing water and others containing dry-cleaning solvents, depending on the nature of the stain to be removed. Extreme caution must be exercised to avoid the use of excessive rubbing or of compounds which may produce damage that will be more of an imperfection in the finished goods than the original stain.

Staple

Filaments of rayon or other man-made fibers, cut to predetermined lengths for conversion to spun yarns (or for other uses). Also used to designate the average length of the natural fibers.

Take-up

The difference between yarn length as it lies in the cloth and its straightened-out length after removal from the cloth, expressed as a percentage of the original length before weaving.

Tenter Frame

A finishing-plant machine in which cloth is gripped on either side by an endless moving chain, held by clips or pins, and used to dry cloth under tension or to hold it out to the desired width while drying.

Throwing

The twisting of continuous filament man-made or silk yarns, usually to medium (voile) or high (crepe) twists.

Tight Ends

Single warp yarns which appear to be under abnormal tension in the fabric, generally extending throughout the full piece.

Tight Picks

Single filling yarns which appear to be under excessive tension in the fabric.

Trammage

The term generally used to describe bands of uneven shrinkage in the filling of a fabric, particularly—but not always—crepes, and starting at shuttle changes. The fabric assumes a fillingwise pucker or plissé appearance.

Twisting-in

The process of joining the single ends of a new warp with those of an old one.

“Twoey” Filling

Some condition which gives a repeat-pattern appearance at regular intervals of every two picks.

Union Dyeing

The dyeing of two or more dissimilar fibers in the same fabric to the same shade in single or successive dye baths.

Warp Streak

Streak running in warpwise direction. This may be further qualified to indicate whether the streak is exactly parallel to the warp yarns or running at an angle, and with some comment on length of the streak. (Some technicians, particularly among our English friends, refer to warp streaks as warp “stripes.”)

Yarn Conditioner

A chamber in which twisted yarn may be placed to be subjected to controlled conditions of moisture (usually through the use of steam) and temperature, to effect a conditioning or setting of the yarn. Cotton-yarn-type conditioners usually have provisions for controlling moisture only. The conditioning serves to remove the liveliness of the twisted yarn.

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APPENDIX

DIAMETERS OF TEXTILE FABRICS

Fiber	Grade	Average diameter, microns
Wool.....	80's	18.8
	70's	20.3
	64's	21.8
	58's	26.3
	56's	28.1
	50's	30.3
Cotton.....		16.0 to 21.0
Flax.....		15.0 to 17.0
Ramie.....		25.0 to 30.0
Cultivated silk..		10.0 to 13.0
Tussah silk.....		28.5
	Filament denier	
Viscose rayon...	1	9.6
	2	13.6
	3	16.7
	5	21.6
	10	30.5
	20	43.1
Acetate rayon and vinyon...	1	10.3
	2	14.5
	3	17.8
	5	23.0
	10	32.6
	20	46.1
Nylon.....	1	11.1
	2	15.7
	3	19.3
	5	24.9
	10	35.2
	20	49.9

YARN NUMBER CONVERSION TABLE *

Cotton, 840 yd. per lb.	Worsted, 560 yd. per lb.	Denier, grams per 9,000 meters	Yards per pound
1.000	1.500	5,315	840
10.00	15.00	531.5	8,400
15.00	22.50	354.3	12,600
<i>17.71</i>	<i>26.57</i>	<i>300.0</i>	<i>14,880</i>
20.00	30.00	265.7	16,800
30.00	45.00	177.2	25,200
<i>35.43</i>	<i>53.15</i>	<i>150.0</i>	<i>29,760</i>
40.00	60.00	132.9	33,600
<i>53.15</i>	<i>79.71</i>	<i>100.0</i>	<i>44,640</i>
60.00	90.00	88.58	50,400
65.00	97.50	81.77	54,600
<i>70.87</i>	<i>106.3</i>	<i>75.00</i>	<i>59,530</i>
75.00	112.5	70.87	63,000
80.00	120.0	66.44	67,200
<i>96.63</i>	<i>144.9</i>	<i>55.00</i>	<i>81,170</i>
<i>106.3</i>	<i>159.5</i>	<i>50.00</i>	<i>89,290</i>
<i>177.1</i>	<i>265.7</i>	<i>30.00</i>	<i>148,800</i>
<i>265.7</i>	<i>398.6</i>	<i>20.00</i>	<i>223,200</i>
<i>531.5</i>	<i>797.3</i>	<i>10.00</i>	<i>446,500</i>

* Most commonly used rayon deniers are set in italics.

SPECIFIC GRAVITY OF FIBERS

Nylon.....	1.14	Linen.....	1.50
Orlon.....	1.17	Ramie.....	1.51
Vicara.....	1.25	Fortisan.....	1.52
Dynel.....	1.28	Cuprammonium rayon..	1.52
Wool.....	1.30	Viscose (bright).....	1.53
Acetate.....	1.33	Cotton.....	1.55
Silk (degummed).....	1.35	Saran.....	1.72
Vinyon.....	1.35	Glass.....	2.56

SOURCES OF SUPPLY FOR LABORATORY EQUIPMENT

(Key on page 360)

<i>Item</i>	<i>Supplier</i>
Abrasion testers	7, 31, 32, 35, 36
Air permeability testers	13, 16, 31, 35
Balances	5, 11, 30, 31
Chemicals and laboratory apparatus	5, 11, 30
Crockmeter	6
Cutting dies	31, 35
Dry-cleaning tumbler	35
Drying testers and ovens	4, 9, 31
Fade-Ometer	2
Fiber microtomes	8, 21
Flammability tester	35
Flat presses	24, 26, 34, 35, 37
Gas-fading Chamber	35
Hydrostatic pressure tester	31
Laboratory furniture	17, 20
Launder-Ometer	2
Microscopes, projectors, and lighting accessories	1, 3, 18, 31
Multifiber test fabric	33
Perspirometer	23
Pick glasses and thread counters	3, 10, 19, 22, 25, 31
Rain Tester	21
Reversing wash wheel	12
Sanforizing marker	27
Spray Tester	6
Tensile strength machines (yarn and fabric)	28, 31
Thickness gauge	31
Twist testers	28, 31, 35
Universal Yarn Numbering Balance	31
Yarn Evenness Controller	29, 31
Yarn reels	29, 31

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Buffalo, New York
2. Atlas Electric Devices Co.
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Chicago, Illinois
3. Bausch and Lomb Optical Co.
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4. Brabender Corporation
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Arlington, New Jersey
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3406 Lancer Drive
Hyattsville, Maryland
9. Harry W. Dietert Company
9330 Roselawn Avenue
Chicago, Illinois
10. John A. Eberly
Reading, Pennsylvania

11. Eimer and Amend
633 Greenwich Street
New York, New York
12. Robert Ewing and Sons, Inc.
Troy, New York
13. Sherman W. Frazier Co.
953 15th Street, S.E.
Washington, D.C.
14. George W. Gates & Co., Inc.
Franklin Square
Long Island, New York
15. General Electric Vapor Lamp Co.
Hoboken, New Jersey
16. W. & L. E. Gurley Company
Troy, New York
17. Laboratory Furniture Co., Inc.
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18. E. Leitz, Inc.
304 Hudson Street
New York, New York
19. Charles Lowinson
475 Fifth Avenue
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20. Metalab Equipment Corp.
1529 Dean Street
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21. Mico Instrument Company
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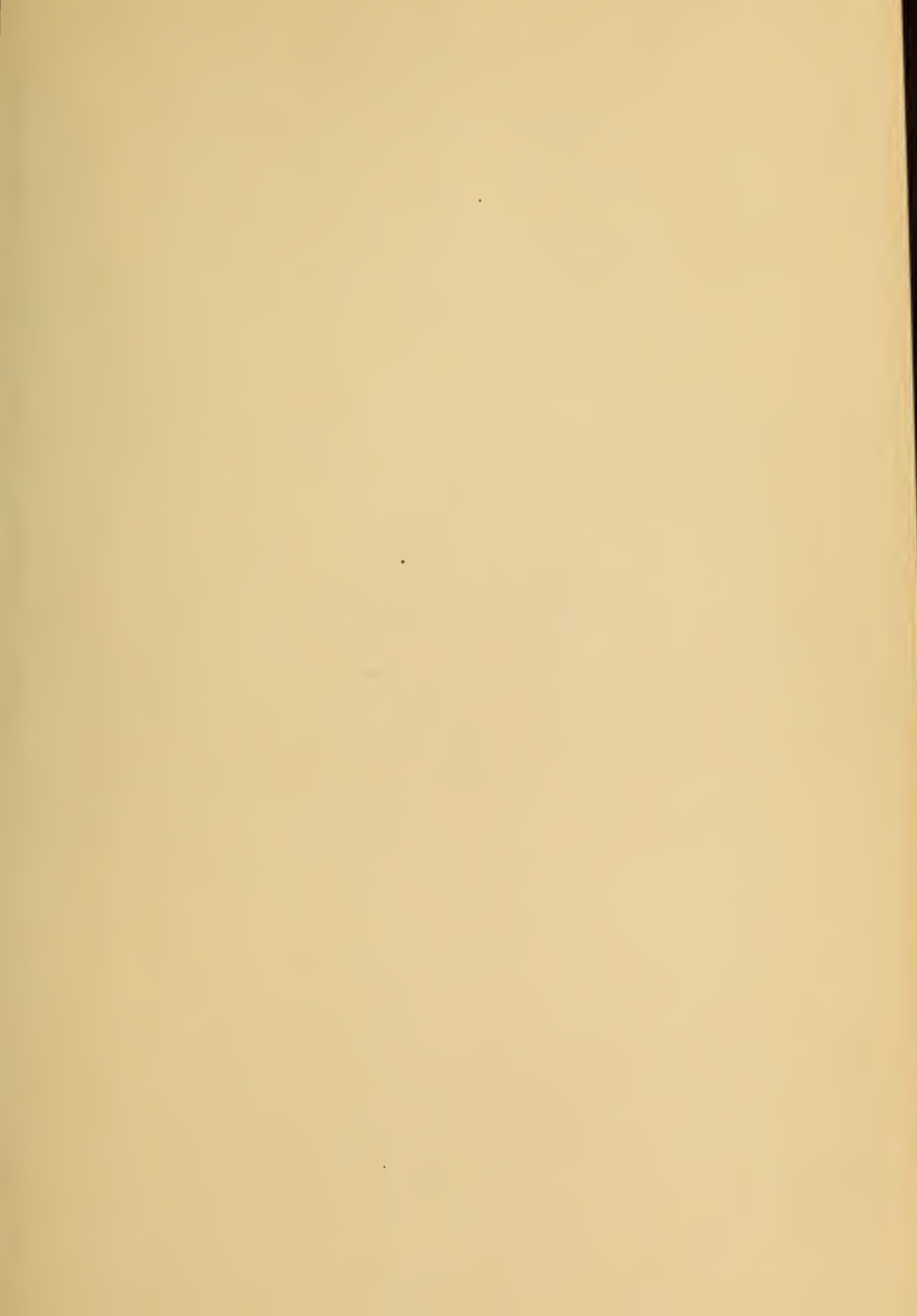
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